STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

A BRIEF HISTORICAL OVERVIEW OF ANACONDA COPPER MINING COMPANY'S PRINCIPAL MINING AND SMELTING FACILITIES ALONG SILVER BOW AND WARM SPRINGS CREEK, MONTANA

JANUARY 1995

A Brief Historical Overview of Anaconda Copper Mining Company's Principal Mining and Smelting Facilities Along Silver Bow And Warm Springs Creeks, Montana

Prepared for

State of Montana
Department of Justice
Natural Resource Damage Litigation Program
Helena, Montana

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Missoula, Montana

January 10, 1995

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1.0 Introduction

The following report was prepared by Historical Research Associates, Inc. (HRA) for the Montana Department of Justice. The report presents historical documentation of hazardous substances discharged or deposited in Silver Bow Creek, Warm Springs Creek and the Clark Fork River by the Anaconda Copper Mining Company and its predecessors in interest. The Anaconda Copper Mining Company and its predecessors played a dominant role in the mining history of Silver Bow and Deer Lodge Counties (Figure 1). These companies, who began operations in Butte during the 1870s, were responsible for large-scale copper production and also for the production of large quantities of waste that were deposited into adjacent streams. The Anaconda Copper Mining Company, and its holding company, controlled many of these operations prior to 1910. The company formally acquired most of the early Butte mining facilities in 1910 and, pursuant to various agreements, assumed responsibility for past and present operations.

This report consists of three principal sections. Section 2.0 of this report discusses the significant role of the Anaconda Copper Mining Company in the copper industry in Butte and Anaconda. A summary of the deposition of substances from the principal mining and smelting operations along Silver Bow and Warm Springs Creeks and the Clark Fork River is presented in Section 3.0. A discussion of the Anaconda Ponds System and the Rocker Timber Framing and Treating Plant is included in this section. A summary conclusion forms Section 4.0 of the report.

2.0 The Significance of The Anaconda Copper Mining Company In The Industrial History Of Silver Bow and Deer Lodge Counties

The trustees of the Anaconda Copper Mining Company announced to its stockholders in its annual report for 1910 that it had formally purchased numerous mining properties in Butte, Montana. As noted by company officials in that report "On April 1, 1910, the operations of the different Companies purchased were unified under the direct management of the officials of the Anaconda Copper Mining Company, and since that time have been operated as departments of

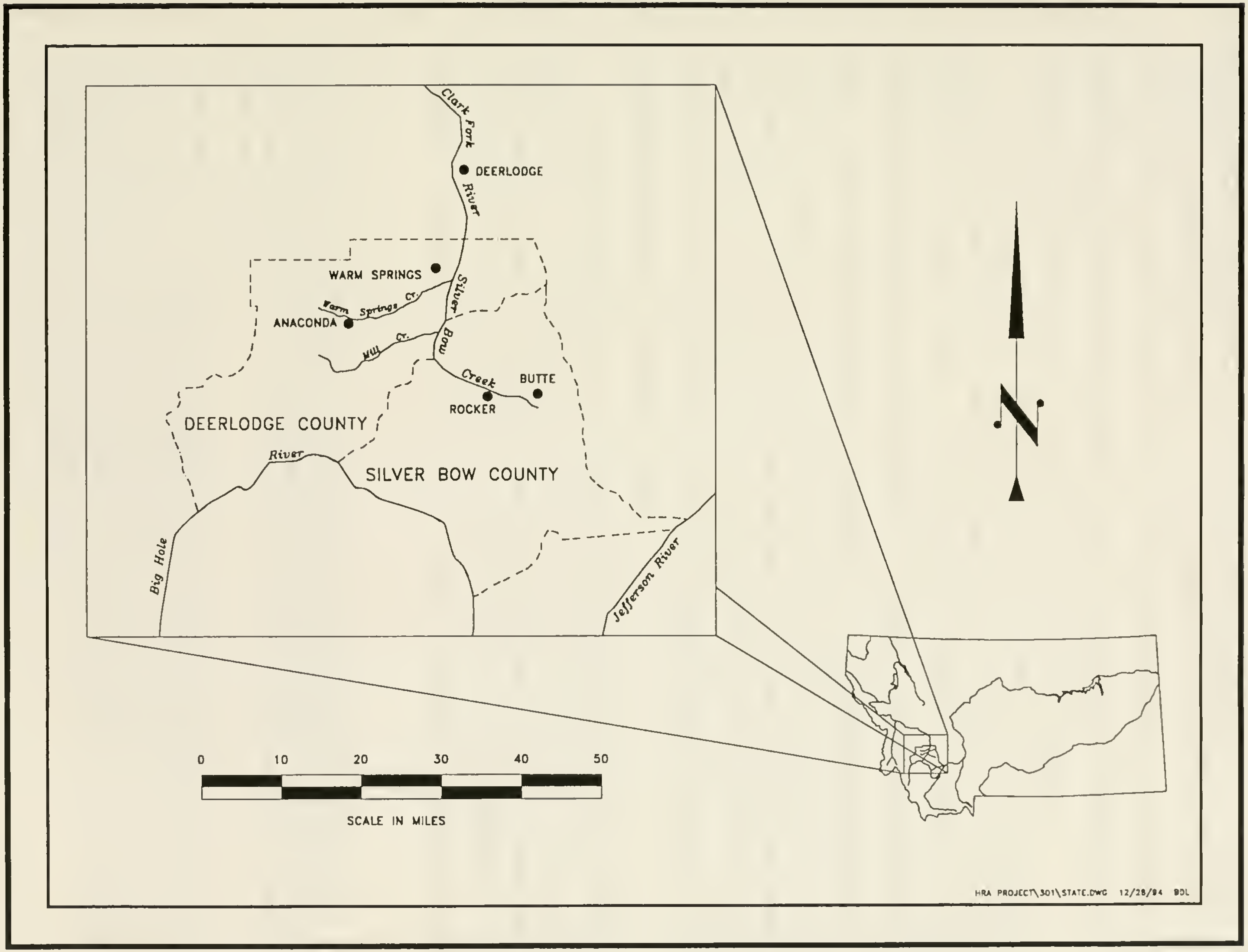

Figure 1. Silver Bow and Deer Lodge Counties, Montana.

that Company." The companies listed as purchased in the annual report for 1910 were the Boston and Montana Consolidated Copper and Silver Mining Company, the Red Metal Mining Company, the Washoe Copper Company, the Butte and Boston Consolidated Mining Company, the Big Blackfoot Lumber Company, the Trenton Mining and Development Company [formerly the Colorado Smelting and Mining Company], the Parrot Silver and Copper Company, the Alice Gold and Silver Mining Company and the Diamond Coal and Coke Company.[1]

Anaconda Copper Mining Company officials claimed that the 1910 acquisitions would generate greater profits through operational economies and efficiencies. The consolidation accomplished much more. While rationalizing mining and smelting operations in Silver Bow and Deer Lodge Counties, the acquisition of all of the major mining and smelting properties in Butte by a single entity also effectively ended years of costly litigation over mining claims. It signaled the emergence of a fully integrated natural resources company that boasted lumber and coal holdings, as well as the control of water and water power sites.[2] In 1910, the Anaconda Copper Mining Company laid claim to an industrial legacy in south-central Montana that had its origins in the placer gold and silver mining of the 1860s and 1870s and the copper mining and smelting operations of the 1880s and 1890s.

The early mining history in Silver Bow and Deer Lodge Counties can be divided into various periods. The first period (1864-1868) was typical of many western mining camps. Initial placer gold finds in 1864 presaged a booming mining camp followed by disappointment over dwindling discoveries in 1868. A second period of mining (1867-1883) saw the development of gold, silver and some copper lodes, which required substantially more

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[1] Anaconda directors also explained to their stockholders how this general consolidation of operations in Butte had brought the properties formerly owned by William Andrews Clark (Original Consolidated Mining Company; Colusa-Parrot Mining and Smelting Company) into the control of Anaconda."Report of the Anaconda Copper Mining Company For The Year Ending December 31, 1910", Montana Historical Society Library and Archives (hereafter MHS), pp. 1-2.

[2] For discussion of these holdings see Michael P. Malone's *The Battle For Butte: Mining and Politics on the Northern Frontier, 1864-1906* (University of Washington Press, Seattle: 1981) pp. 203-207. See also K. Ross Toole's "A History of the Anaconda Copper Mining Company: A Study in Relationships Between a State and Its People and a Corporation: 1880-1950," Ph.D. dissertation, University of California, Los Angeles, 1954. For a discussion of the Anaconda Copper Mining Company's involvement in emerging water power production see Alan S. Newell, "A Victim of Monopoly: Samuel T. Hauser and Hydroelectric Development on the Missouri River, 1898-1912," Master's thesis, University of Montana, 1979.

investment in monetary and human capital. This era of more capital intensive mining also supported the expansion of the community of Butte, which boasted a population of 4,000 in 1875 and, by 1881, claimed over 14,000 residents.[3]

The emergence of large scale copper mining in the district during the early 1880s dwarfed both of these two early periods of mining in Butte and along Silver Bow Creek. During this period, various entities, which were later subsumed by the Anaconda Copper Mining Company, mined and smelted ores in the area. William Andrews (W.A.) Clark, Montana pioneer, banker and erstwhile prospector purchased his initial claims in Butte in 1872. Clark, along with other Montana pioneer investors sought to smelt ores in Butte, rather than to ship them to Swansea, Wales for processing. Exploiting connections in Colorado, Clark created the Colorado Smelting and Mining Company in 1879 and opened a smelter along Silver Bow Creek. Clark and others joined in 1880 to organize the Parrot Silver and Copper Company, which, by 1881, was producing a high grade of silver-copper matte (Figure 2).[4] Both entities operated large scale facilities that not only produced valuable smelted copper, but generated large quantities of waste that was deposited along Silver Bow Creek.

W.A. Clark's future protagonist, Marcus Daly, arrived in Butte in 1876 to launch a career that proved of singular importance to the later development of the region. Soon after joining forces with the California-based interests of James Ben Ali Haggin, Lloyd Tevis and George Hearst, Daly purchased the Anaconda Mine and proceeded to erect a new smelter works 26 miles west of the city, on Warm Springs Creek.[5] Until 1891, the Daly-Haggin-Tevis-Hearst

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[3] Isaac F. Marcossan, *Anaconda* (Dodd, Mead and Co.: New York, 1957) p. 24; Harry C. Freeman, *A Brief History of Butte, Montana: The World's Greatest Mining Camp* (Henry O. Shepard Co.: Chicago, 1900) p. 18.

[4] Malone, *Battle For Butte*, pp. 15-16, 21-22; see also Donald MacMillan, "Andrew Jackson Davis, A Story of Frontier Capitalism, 1864-1890," Master's thesis, (Missoula: University of Montana, 1967).

[5] See Marcossan, *Anaconda*, pp. 32-35, 46-52. See also Malone, *Battle For Butte*, pp. 24-32.

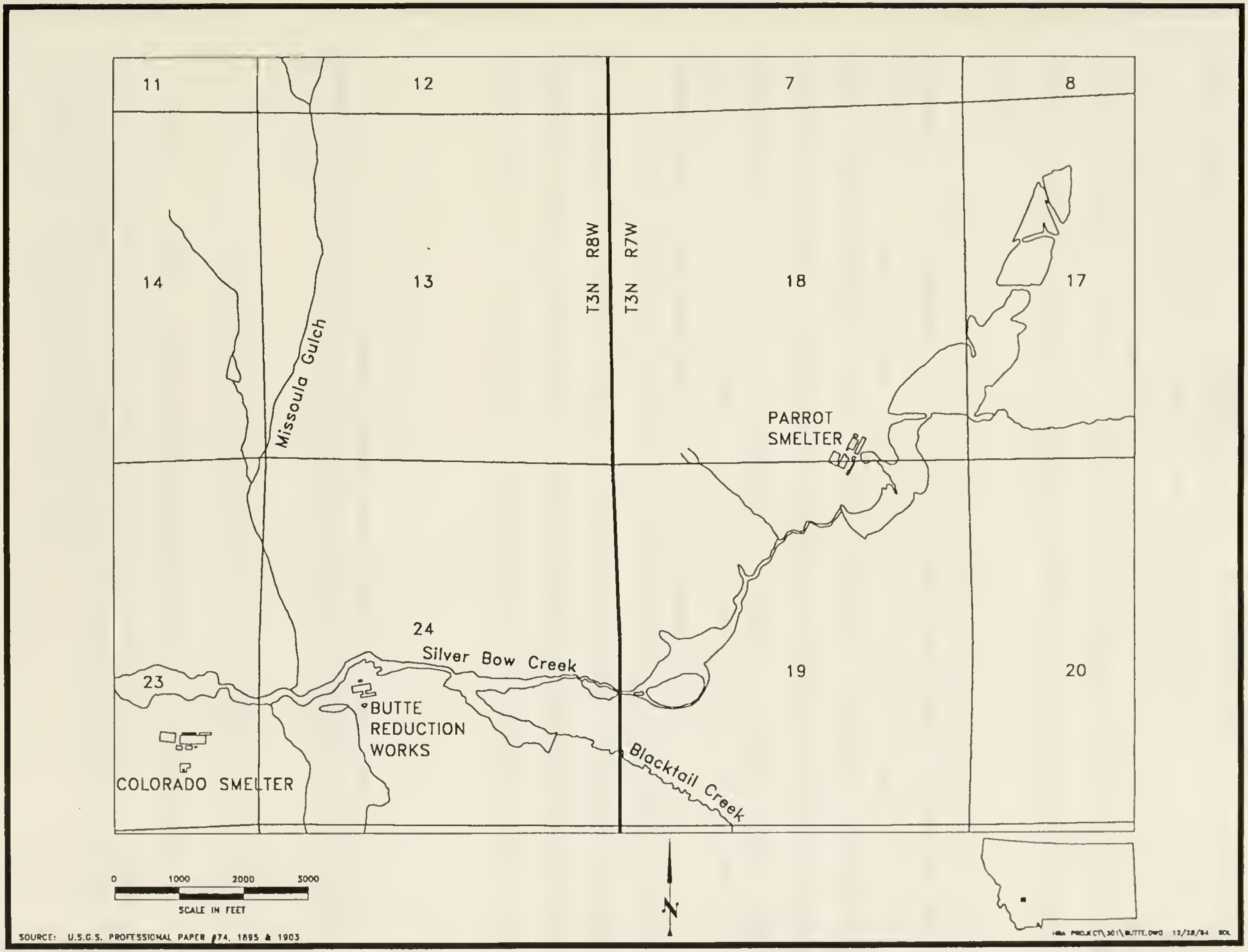

Figure 2. Major Smelter Facilities along Silver Bow Creek.

syndicate operated as a partnership in developing the Anaconda and other mines in Butte and the smelter works at the new city of Anaconda.[6]

The town and smelter at Anaconda grew rapidly following their location in the spring of 1883. Workers completed construction of the "Upper Works" in 1884 and the first copper matte was produced that October. A few years later (1887-89) the syndicate completed work on the "Lower Works" and, despite a brief hiatus in 1894, both facilities continued in operation until 1902.[7]

The expansion and profitability of the syndicate properties dictated a more formal organization of the company. On January 19, 1891, Daly, Haggin, Tevis, and Hearst incorporated the Anaconda Mining Company with an initial issuance of stock.[8] The death of George Hearst in 1891, sale of a large block of his shares by the estate to the London-based Exploration Company Ltd. and financial reversals due to the Panic of 1893 forced an additional reorganization in June, 1895. The corporation was renamed the Anaconda Copper Mining Company. The newly reformed company acquired all of the property of the Anaconda Mining Company and continued operations at the Upper and Lower Works.[9]

By the late 1890s, the large capital required for efficient copper production had dictated the consolidation of interests in Butte as well as in Anaconda. The Butte and Boston Consolidated Mining Company and the Boston and Montana Consolidated Copper and Silver Mining Company, which had operated in Butte since the 1880s, combined in 1897 and were

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[6] During Daly's lifetime, the syndicate employed a variety of names, including the Anaconda Mining Company, the Anaconda Mining and Smelting Company and the Anaconda Gold and Silver Mining Company. "Historical Events," August 1, 1927, Environmental Protection Agency (EPA) Administrative Record, File No. 4010603/420803.

[7] Toole, "A History of the Anaconda Copper Mining Company," pp. 23-24. See also, "Historical Events," p. 1.

[8] Marcossan, *Anaconda*, p. 57. See also Malone, *Battle For Butte*, p. 45 and "Historical Events," p. 2.

[9] "Historical Events," p. 4. See also, Malone, *Battle For Butte*, p. 46; Toole, "A History of The Anaconda Copper Mining Company," p. 81-82; and "Response To C(3)(b) of Enclosure I of CERCLA 104(e) Information Request; EPA Letter Dated May 17, 1988, From John F. Wadell, Director Montana Office, EPA Region VIII, To H.L. Bilhartz, Vice President, Atlantic Richfield Company."

followed soon thereafter by W.A. Clark's consolidation of his properties.[10] The most significant consolidation, however, occurred in 1899, when Marcus Daly's Anaconda Copper Mining Company was subsumed within the Amalgamated Copper Company.

Contemporary writers and later historians offer a number of reasons for the creation of the Amalgamated Copper Company. Recognition of the potential for copper in a world rapidly electrifying its cities was certainly a motivation. Moreover, as noted above, other entities in Butte were undergoing consolidation during the late 1890s and the benefit of combining the myriad of mining claims in Butte was apparent to most investors. This point was becoming increasingly apparent as smaller operators, such as F. Augustus Heinze were able to exploit the 1872 mining law's "apex principle" to gain access to adjacent mining claims.[11] H.H. Rogers, William Rockefeller and the Standard Oil interests behind Amalgamated also may have considered the possibility of cornering the copper market, at least in the United States, through acquisition of the nation's principal copper mines in Butte.[12]

All of these reasons for Amalgamated's involvement in Butte are valid to one degree or another. What is also true is that the Amalgamated Copper Company was always a "holding" company. The Anaconda Copper Mining Company remained the "operating" company in Butte and Anaconda.[13] The most dramatic example of the company's direction was the gradual closure of inefficient smelters in Butte and the concurrent expansion of smelter facilities in Anaconda.

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[10] Toole, "A History of the Anaconda Copper Mining Company," p. 113. These companies were later consolidated with the Anaconda Copper Mining Company.

[11] Under the terms of the "apex principle," the owner of a claim could mine a mineral vein that originated on the claim laterally, even if the vein extended beyond the surveyed limits of the claim — if he could prove that the vein was not terminated by a natural fault.

[12] For a review of these various motivations see Marcossan, *Anaconda*, pp. 94-96; Toole, "A History of the Anaconda Copper Mining Company," pp. 112-113; Malone, *Battle For Butte*, pp. 134-140. For more contemporary views of the formation of Amalgamated, see *The Engineering and Mining Journal*, vol. 79 (June 8, 1905) p. 1103; F. Ernest Richter, "The Amalgamated Copper Company: A Closed Chapter In Corporation Finance," *Quarterly Journal of Economics*, vol. 30 (Nov., 1915) pp. 405-407; George Walker, "The Copper Mines of Butte and the Amalgamated Copper Company," (Boston: Boston Financial News, 1900) pp. 8-9; and Thomas Lawson, *Frenzied Finance*, vol I: *The Crime of Amalgamated* (New York: The Ridgway-Thayer Co, 1905), pp. 245-260.

[13] Marcossan, *Anaconda*, p. 96.

Soon after acquiring major interests in the Parrot Smelter, Butte and Boston and Boston and Montana companies, and the Colorado Smelter (owned at this time by the Trenton Mining and Development Company), the smelters closed and ores were thereafter processed at the smelter in Anaconda. To handle the increased volume, the Anaconda smelting facility expanded in 1902 with completion of the Anaconda Reduction Works.[14] The company renovated that facility in 1903 with the addition of new flues and stacks.[15]

By 1900, the Anaconda Copper Mining Company was the largest single employer in Silver Bow and Deer Lodge Counties. The company's facilities employed roughly 6,000 men in Butte alone.[16] Despite its dominance of production in the mining district, the Anaconda was not the only company operating in Butte. The operations of F. Augustus Heinze's Montana Ore Purchasing Company smelter, located in the Meaderville district of Butte, were never a serious financial threat to the Anaconda Copper Mining Company or its holding company. However, Heinze's efforts to remain independent were a constant nuisance to the much larger company.

Historians have recounted in elaborate detail the final battle in the "war of the copper kings" between Heinze and the Anaconda Copper Mining Company's holding company, the Amalgamated Copper Company.[17] Using various devices, Heinze was able to retain control of his properties until 1903. In October of that year, Anaconda's holding company announced the closure of all of their facilities in Montana. According to some calculations, the shutdown

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[14] Donald MacMillan, "A History Of The Struggle To Abate Air Pollution From Copper Smelters Of The Far West 1885-1933," Ph.D. dissertation, University of Montana, 1973, pp. 107-109. The Colorado Mining and Smelting Company was reorganized as the Trenton Mining and Development Company in 1904. The Anaconda Reduction Works also was known as the "Washoe Smelter", the "New Works", or simply as "Smelter Hill."

[15] Ibid., pp. 115-116; Marcossan, *Anaconda*, p. 105.

[16] These figures are derived from Freeman, *A Brief History of Butte*, pp. 65-85.

[17] Sarah McNelis offered the first account of this struggle in her Master's thesis entitled "The Life of F. Augustus Heinze", Master's thesis, Montana State University, Missoula, 1947. This was followed later by her *Copper King At War: The Biography of F. Augustus Heinze* (Missoula: University of Montana Press, 1968). The first comprehensive account of this struggle was K. Ross Toole's 1954 Ph.D. dissertation "A History of The Anaconda Copper Mining Company." Toole incorporated much of the essence of that early work in various articles and in his history of the state, *Montana: An Uncommon Land* (Norman: University of Oklahoma Press, 1959). Finally, Michael Malone's more recent book, *Battle For Butte* provides a new synthesis of the events surrounding this intriguing series of events.

affected roughly four fifths of the state's wage earners.[18] Only after the Montana legislature passed a "fair trials" act allowing for the removal of pending litigation from the overly friendly Heinze court in Butte did Anaconda and its holding company send men back to work.[19] Heinze remained in the copper business a few more years, but his position as an independent was untenable. His Montana Ore Purchasing Company was reincorporated as the Red Metal Mining Company in 1906, a wholly-owned subsidiary of the Butte Coalition Mining Company. The Butte Coalition Mining Company, in turn, was owned by the Amalgamated Copper Company, the Anaconda Copper Mining Company's holding company.[20]

With acquisition of the Heinze properties, the Anaconda Copper Mining Company and its holding company essentially controlled copper production in Silver Bow and Deer Lodge Counties. The final step in solidifying the company's control was the acquisition of Clark's properties, including the Butte Reduction Works in 1910 and the absorption of the Butte Coalition properties. Both entities eventually passed to the Anaconda Copper Mining Company.[21]

In the 1910 acquisition, the Anaconda Copper Mining Company also formally received title to other Butte properties, such as the mines and claims owned by the Boston and Montana Consolidated Copper and Silver Mining Company, the Butte and Boston Consolidated Mining Company, and the Alice Gold and Silver Mining Company. The Anaconda Copper Mining Company also received the Parrot Smelter, the Trenton Mining and Development Company's Colorado Smelter and the Washoe Copper Company. Although the Parrot Smelter had closed in 1899 and the Colorado Smelter in 1904, both entities still owned tailings and other wastes that would later prove valuable to the Anaconda Copper Mining Company. The language in the transfer documents for these properties was similar:

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[18] K. Ross Toole, "The Great Shutdown" in *Twentieth Century Montana: A State of Extreme* (Norman: University of Oklahoma Press, 1972) pp. 99-122.

[19] Ibid., p. 121.

[20] Malone, *Battle For Butte*, p. 187.

[21] Marcossan, *Anaconda*, 140; Malone, *Battle For Butte*, p. 196; "Report of the Anaconda Copper Mining Company for the Year Ending December 31, 1910" pp.1-2.

> The said second party agrees to take over, and does hereby take over, the said business and property of the said first party as a going concern; said sale and transfer to be made as of, and take effect from, the last hour of the 31st day of March A. D. 1910; and to carry out and fully perform and discharge all contracts, obligations and liabilities, of every kind, character and description, whether in contract or in tort, and whether now or hereafter enforceable against the first party, and to undertake to and fully carry out and completely perform, all valid executory provisions of any contract or contracts which may exist at the date of the transfer and delivery of all of the property and assets of the said first party to the said second party.[22]

Consolidation of the Butte mines and smelters into the Anaconda Copper Mining Company in 1910 ended a process that had been underway since the late 1890s. The integrated industrial process of mining ore in Butte and shipping it to the Anaconda smelter via the company owned Butte, Anaconda, and Pacific Railway was well-established by 1910. The Anaconda Copper Mining Company was the industrial giant in the state, with vast holdings throughout western Montana and broad influence over, if not control of, political developments.[23] By 1910, the significance of the Anaconda Copper Mining Company to the economy of the state and specifically Silver Bow and Deer Lodge counties was clear to all Montanans.

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[22] Indenture, Parrot Silver and Copper Company to Anaconda Copper Mining Company, May 31, 1910, Deed Book 98, Office of the Silver Bow County Clerk and Recorder's Office, Silver Bow County, Butte, Montana, pp. 135-142; Agreement, Anaconda Copper Mining Company and Trenton Mining and Development Company, May 26, 1910, EPA Administrative Record, File No. 4010603/420328.

[23] The role that the Anaconda Copper Mining Company played in Montana politics between 1910 and the mid-1950s is the subject of debate. K. Ross Toole, beginning with his Ph.D. dissertation and continuing through much of his writings and lectures, identified a wide range of influence that the "Company" exercised in the political life of the state. Michael Malone, in his "Montana As A Corporate Bailiwick: An Image in History", in *Montana Past and Present: Papers Read At A Clark Library Seminar, April 5, 1975* (Los Angeles: University of California, 1976) pp. 57-76, tries to place the popular perception of the company's role in perspective with other interests and the state's political tradition.

3.0 Principal Mining and Smelting Operations Along Silver Bow And Warm Springs Creeks

3.1 Copper Mining and Smelting in the Butte Area

The era of large-scale copper production in Butte, Montana began during the early 1880s' when mine owners, frustrated by the diminishing presence of gold and silver in their quartz mines, turned their attention to mining abundant copper ore. The ascendancy of copper revived mining and smelting prospects for the Butte area and transformed an ephemeral gold and silver mining "camp" into one of the greatest copper ore production centers in the world. Renewed mining and smelting also created a number of environmental and health problems for the residents of the community. Reportedly, the Butte Valley, prior to the increase in copper mining, had been a relatively pristine environment with the hills and valley floors covered with natural vegetation, including wildflowers, strawberry and alder bushes and other native plants. The increase in copper mining and smelting during the 1880s and the 1890s seriously altered this bucolic setting.[24]

The large mining and smelting concerns that came to dominate both the mining and processing of the copper ores of Butte, required a dependable water source. Thus companies typically located their processing facilities near, or adjacent to Silver Bow Creek, the only available, perennial stream in the Butte Valley. By the mid-1880s, several of the largest mining and smelting concerns had established reduction or smelting plants along the banks of Silver Bow Creek to avail themselves of this relatively meager water supply.[25] These companies deposited the waste material, or tailings, from their smelters into ponds adjacent to their plants or directly into Silver Bow Creek. Some of this material eventually washed down the creek into

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[24] Ralph I. Smith, *History of the Early Reduction Plants of Butte, Montana*, Montana Bureau of Mines and Geology, (Butte: Montana School of Mines, May, 1953), [Reprint from *De Re Metallica*, vol. 18, nos. 2 and 3], pp. 8-10. See also, Donald MacMillan, "A History Of The Struggle to Abate Air Pollution From Copper Smelters Of The Far West 1885-1933," p. 13.

[25] MacMillan, "A History Of The Struggle to Abate Air Pollution," p. 12.

the Clark Fork River.[26] Since the early smelters lacked the technology to extract efficiently either copper or other minerals from the ore, the tailings piles contained significant amounts of metal, as well as other hazardous substances. In addition to the waste materials that the smelters deposited along the banks of the creek, each of the mining companies operated deep lode mines. At a certain depth, the miners encountered groundwater, which if not removed would have curtailed further mining. Most of the companies installed powerful pumping plants in the mines to remove the mine water. The water, heavily laden with metals was pumped out of the mines and flowed downhill to Silver Bow Creek.

In the late 1890s, one observer commented that the combined effects of the mining and smelting operations had dramatically changed the stream.

> Between Butte and Missoula the lovely and limpid river which Lewis and Clark marveled at is now transformed into a muddy, slimy, dirty river, as foul looking as that of Chicabo, the Tiber or the Yarra-Yarra. Along its banks have grown up communities rich, even luxurious, and the wonderous [sic] prosperity of Butte is responsible for the destruction of the beauty of the once lovely Hell Gate River.[27]

These early operations lacked the technological advancements of later copper concentrators and the initial method of reduction included heap or stall roasting copper ore to remove the sulphur. Heap roasting consisted of intermixing layers of copper ore and thick wooden timbers in a long open trench and then lighting the timbers. The heaps would often burn for weeks at a time, continuously emitting vast amounts of mineral laden fumes. Stall roasting followed the same basic principles as heap roasting. The ore was placed in small metal stalls again using wood as the combustible agent. The stalls had low stacks that also sent the resulting toxic fumes into the atmosphere.[28]

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[26] The Clark Fork River was known at various times as the "Missoula," "Deer Lodge," and "Hell Gate" River.

[27] P.A. O'Farrell, *Butte: Its Copper Mines And Copper Kings*, (New York, Printing House of James A. Rogers, 1899) p. 48.

[28] MacMillan, "A History of the Struggle to Abate Air Pollution," p. 17.

The daily emissions of the heaps and stalls of the Butte smelters coupled with air inversions common to the Butte Valley so fouled the air that the entire city often was totally obscured from view from the surrounding hillsides. For the residents of the city, life during an inversion required extra precautions:

> Carriages had to be driven slowly for fear of knocking pedestrians down. Railroad engines collided with one another in the switching yards. Trolley cars had to creep through the streets ringing their bells constantly; at night the conductors walked ahead of them with lanterns in their hands. Many people experienced bleeding from their noses and some vomited in the streets.[29]

The vegetation that had once covered the valley soon died and by the early 1890s complaints from the citizenry, supported in part by the local press, led the city government in 1891 to issue an ordinance that banned further use of the heap and stall method of roasting ore. The ordinance required all smelters to build stacks for their furnaces that were at least seventy-five feet tall. The ordinance imposed a fine for any violators and most of the smelter operators soon erected stacks for their furnaces. The stacked furnaces proved to be little more efficient than the previous methods of roasting.[30] However, the controversy over air pollution in Butte proper abated somewhat and ended finally during the first decade of the 20th century, as the Anaconda Copper Mining Company purchased the assets of the major smelting operations, closed most of the Butte smelters and concentrated the ore reduction process for most of the Butte mines at the Anaconda Reduction Works. With the closure of smelters in Butte, the Anaconda Copper Mining Company's air pollution problems shifted to the Deer Lodge Valley.

3.2 Smelter Operations at Anaconda

By August 1883, Daly-Hearst-Haggin syndicate, operating as the Anaconda Mining Company, had begun constructing their initial smelting facility 26 miles west of Butte, on the north bank of Warm Springs Creek. Marcus Daly, one of the principals in the company, had

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[29] Ibid., p. 19.

[30] Ibid., pp. 18-103.

foreseen that with the burgeoning number of smelters along Silver Bow Creek the Butte mining industry would soon face a shortage of available clean water, essential to successful smelting. The syndicate selected the site for the company smelter chiefly to ensure a constant, clean water supply. The first facility differed little in operation from the smelters in Butte. The principle difference was in the plants capacity to treat much larger quantities of copper ore. Initially the Anaconda "Upper Works" could treat 500 tons of ore a day. The company expanded and improved the plant within two years and doubled the daily capacity. In 1887, the company again expanded their smelting capabilities by adding an additional smelting facility (known as the "Lower Works") southeast of their first smelter. The new smelter, capable of treating 3,000 tons of ore a day, trebled the company's smelting capacity.[31]

The Upper and Lower Works (often referred to as the "Old Works") satisfied the Anaconda Mining Company's smelting needs until the late 1890s when the company began consolidating the mining and smelting operations of the major companies in Butte. Rather than remodel and expand the Upper and Lower Works, what was now the Anaconda Copper Mining Company chose to increase its production by building an enormous smelter south of Warm Springs Creek. Construction of the Anaconda Reduction Works in 1902 resulted in the largest copper smelter in the world — one that could treat over 7,000 tons of ore a day.[32]

Until the construction of the new smelter, few residents of the Deer Lodge Valley had complained of smoke pollution from smelters in Butte or Anaconda. With the construction of the new smelter, the Anaconda Copper Mining Company was able to double the smelting capacity of the Upper and Lower Works. There was a concurrent increase in the amount of flue dust and fumes emanating from the relatively low stacks of the smelter. Farmers and ranchers in the Deer Lodge Valley began complaining about adverse effects to crops and animals and many filed damage claims against the company. In July, 1903, the Anaconda Copper Mining Company closed the smelter to install a new flue system. The new system was interconnected to all roasting furnaces in the enormous plant and funneled dust 2300 feet uphill

[31] Ibid., pp. 104-105.

[32] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 13; MacMillan, "A History of the Struggle to Abate Air Pollution," pp. 107-108.

through a complex flue system to a 585 foot high stack. The company also installed a relatively inefficient plant to remove arsenic, one of the principle by products of copper smelting, from the fumes.[33]

Despite the addition of the new flue system, the farmers and ranchers in the nearby valley continued to complain of damages to both their crops and animals. Finally, in May, 1905, the Deer Lodge Valley Farmers Association, made up of 107 farmers and ranchers, filed a damage suit against the company in U.S. District Court in Helena. This, in addition to earlier lawsuits, eventually forced the Anaconda Copper Mining Company to seek a resolution to this litigation by purchasing easements and land from disgruntled ranchers.

In addition to the complaints of damage to crops due to smoke, the company also had to respond to suits filed for damages from tailings deposited on farm lands located on Silver Bow and Warm Springs Creeks and on the Clark Fork River. As stated above, most of the major smelters located their plants adjacent to Silver Bow Creek and deposited their tailings either directly into the stream or into ponds near the banks of this watercourse. This, coupled with the toxic mine waters pumped from the company's mines that eventually flowed into the creek, left Silver Bow Creek and the Clark Fork River a sterile, metal laden stream. The tailings from the ponds in Butte periodically washed directly into the creek and carried downstream onto farm lands along Silver Bow Creek and in the Deer Lodge Valley.

The Upper and Lower Works at Anaconda added to the pollution of the river, since their waste was deposited into Warm Springs Creek, a tributary of the Clark Fork River, or into ponds adjacent to the creek. These accumulated wastes periodically washed downstream. With the construction of the massive Anaconda Reduction Works smelter and the concurrent increase in tailings generation, the company began construction of a system of tailings and "slime" ponds north and east of the smelter, near the Clark Fork River. During the first decades of the 20th century, the company allowed a portion of the waste to overflow the tailings and slime ponds into the Clark Fork River. Moreover, the dike system built to retain the tailings and slimes frequently broke resulting in deposition of large quantities of tailings and slimes into the river and onto nearby farm lands.

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[33] Ibid., pp. 104-116.

During the early decades of the 20^{th} century the Anaconda Copper Mining Company, as the successor in interest to many of the large mining and smelting companies in Butte responded to many of the damage suits filed by area ranchers by claiming a prior right to deposit waste material. Eventually, the company was forced to settle many of the tailings damage suits by either purchasing lands or a tailings/smoke easement that allowed it to continue to operate the smelter.

3.3 Mine Water Pumping in the Butte Area

Prior to the initiation of lode mining in the Butte Valley, the annual precipitation, in the form of rain and snowfall, either evaporated quickly or was deposited into Silver Bow Creek as runoff. The advent of extensive underground mining in Butte resulted in the creation of hundreds of mine portals that acted as receptacles for runoff water. Instead of flowing into Silver Bow Creek, much of the yearly precipitation was absorbed by the highly fractured and porous, surface workings that acted as catchment basins for runoff water. The water then percolated into the underground mine workings joining, at some point, the water table. During percolation, the runoff water, came into contact with mineral veins exposed by miners, which resulted in a metal charged mine water. This water, coupled with the natural groundwater encountered when the individual shaft depth reached the metal enriched groundwater table, had to be removed to continue mining.[34]

By the early 1880s, the main shafts of most of the major producing mines in Butte had reached the groundwater table, and mine owners had to install pumping equipment to allow their workers to continue development.[35] Initially, mine owners allowed the metal-laden mine water

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[34] Walter Harvey Weed, "Geology And Ore Deposits Of The Butte District", *Professional Paper #74*, United States Geological Survey (U.S.G.S.), (Washington D.C.: Government Printing Office [GPO], 1912), p. 97.

[35] The Montana Inspector of Mines conducted a yearly inspection of all of the lode mines in Silver Bow County. The Inspector reported on the safety equipment in place in each of the mines as well as the type of hoisting equipment and mine dewatering devices. A review of the Inspectors' reports for the late 1880s and throughout the 1890s indicates that most of the mines used some type of mine pump to remove the mine water. See; *Reports of the Montana Inspector of Mines for the years 1889-1900*, (Helena, Montana: Journal Publishing Company).

to flow untreated down Butte Hill and to enter Silver Bow Creek. A fire in the St. Lawrence Mine, owned by the Daly-Haggin-Hearst syndicate, in November 1889, prompted a reevaluation of this practice. The owners of the St. Lawrence attempted to extinguish the fire by flooding the shaft with water. When the fire was eventually controlled, the water in the St. Lawrence and adjacent shafts had to be pumped out. The mine water, rich in copper, apparently:

> ... flowed through the yard of a man named Miller who ... enlarged and cleaned out the ditch which carried this rich copper-bearing water through his yard, placed scrap iron and tin cans in the ditch, and thus began the precipitation of cement copper. Subsequently he improved his little plant by building some boxes and flumes of old lumber. He sold precipitate, in small lots, to the Colorado Smelter.[36]

A year after Miller successfully worked the water from the St. Lawrence, William Ledford obtained a lease from the Anaconda Mining Company to precipitate the copper from the waters flowing from the St. Lawrence. Ledford first dug holes along the water course and then filled them with scrap iron and tin. He added a 40 foot wooden flume to his operation which he also lined with scrap metal and tin. Ledford's operation was so successful that the Anaconda Mining Company refused to renew his lease after it expired and the company built their own precipitating plant. By the mid-1890s most of the major mining companies had established precipitation plants at their mines.[37]

The Anaconda Copper Mining Company installed a major precipitation plant at their High Ore mine in 1901. Many of the company's mine properties had become interconnected as the shafts had expanded laterally. Thus, the High Ore plant served as the central dewatering shaft for most of the company's mines. By the second decade of the 20th century, after the consolidation of the major mining operations in Butte under the Anaconda Copper Mining Company, the company was operating two additional precipitation plants, one at the Leonard Mine and the other at the Silver Bow.[38]

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[36] J.C. Febles, "The Precipitation of Copper from the Mine Waters of the Butte District", in *Transactions of the American Institute Of Mining Engineers*, Vol. XLVI, 1914, pp. 178-179.

[37] Ibid., p. 179.

[38] Febles, "The Precipitation of Copper from the Mine Waters of the Butte District", pp. 184-188.

After the majority of the easily removed copper was precipitated, the "tail water" was used again by individuals to leach "soluble copper" from mine dumps and tailings piles. According to one author, the:

> ...tail water from the precipitating plants, containing considerable ferric sulphate, is quite suitable for leaching this material. Thus some of the copper still in the form of sulphide, in addition to all of the copper sulphate, can be removed, owing to the solvent action of the ferric sulphate upon sulphide and other copper minerals.[39]

The tail water would be directed to the top of a mine dump and allowed to percolate through the dump material. The operators dug a trench around the base of the dump and tunnels were driven into the interior of the dump. The water that flowed out of the tunnels and into the trench was again pumped to the nearest precipitating plant.[40]

The total volume of water pumped from the many mines on Butte Hill was enormous. When O.E. Meinzer investigated the water supply in the Butte area in the fall of 1912, he estimated that the total mine water entering Silver Bow Creek amounted to 10 second feet per year or "... between 4,000 and 5,000 gallons per minute continuously."[41] Consequently, the Anaconda Copper Mining Company was economically motivated to monitor the effectiveness of the precipitation plants in removing copper from mine water. The company periodically improved the plants to ensure that an economic amount of copper was being removed prior to entering Silver Bow Creek. In a 1931 report on the efficiency of the company's precipitation plants, J. R. Cooper, an Assistant Research Engineer for the company, wrote that "The water leaving the precipitating plants is very low in copper." Cooper believed that the recovery of copper from both the High Ore and the Leonard plants was probably "... as high as can be economically maintained."[42]

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[39] Ibid., p. 191.

[40] Ibid.

[41] O.E. Meinzer, "The Water Resources Of Butte Montana", *Water Supply Paper # 345-G*, U.S.G.S., (Washington D.C.: GPO, 1914), pp. 93-94.

[42] J.R. Cooper, "Investigation Of High Ore And Leonard Butte Mine Water Precipitation Plants," January 6, 1931, Box 240, File 240-6, ACM Papers, MS 169, MHS, Helena, Montana, p. 13.

That same month Cooper wrote to L.V. Bender, the General Superintendent of the Anaconda Reduction Works. Cooper informed Bender that he [Cooper] had tested the waters of Silver Bow Creek near the point where the "tail water" from the precipitating plants entered the creek. His samples showed that the water turned into the creek from the precipitation plants still contained levels of copper, iron, white arsenic, chlorine and other minerals in varying amounts. Cooper restated his opinion that the cost of treating this water further would be prohibitive.[43]

3.4 Streamside Tailings/Silver Bow Creek

The operation of the mines and smelters in Butte between the late 1870s and the early years of the 20th century resulted in the deposition of thousands of tons of slag, slimes, tailings and mine wastes throughout the valley. The major reduction facilities and smelters were located on the banks of, or in close proximity to Silver Bow Creek, since water was essential in the processing of ore. The slag, slimes and tailings, a by-product of the reduction and smelting process, were flumed away from the plants onto lands near the creek and in some cases directly into the stream. These wastes ultimately were deposited on downstream lands.

Anaconda Copper Mining Company engineer F.C. Noble investigated the problem of the deposition of mine wastes on Silver Bow Creek at its juncture with Warm Springs Creek and the Clark Fork River in 1911. Noble reported on the claim of rancher Ed Whitcraft that tailings deposition had damaged crops on 96 acres of Whitcraft's land adjacent to the Clark Fork River. The company directed Noble to survey the land and to prepare cost estimates for altering the channel of the river to prevent future damage.[44] Noble stated that the Anaconda Copper Mining Company had paid for tailings damage to Whitcraft's lands in 1901 and, in fact, had acquired a tailings easement on approximately 320 acres at that time from Whitcraft's father. However, high water in 1910 had damaged an additional 96 acres. Noble encouraged

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[43] J.R. Cooper to L.V. Bender, January 14, 1931, Box 240, File 240-6, ACM Papers, MS 169, MHS, Helena, Montana.

[44] William Wraith to D.A. Welch, September 2, 1911, Box 441, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

the company to pay Whitcraft for the recent damages and to acquire another easement. According to Noble, the earlier easement:

> ... was and is for a *heavy* deposit of tailings over *most* of this overflowed area and to damages to lands and *loss of profits* to crops over a series of years ... so that even if the portion of this ranch now owned by Mr. E. Whitcraft and but recently overflowed in 1910, *is* overflowed for the next several years, I don't see how the rate of settlement per acre will be more than $20.00 per acre judging by the precedents of the past, and the Company is no more under obligations to go to any expense to keep tailings off of this land than off all other bottom lands in Deer Lodge Valley especially after once overflowed.[45]

Noble discouraged the company from attempting to alter the course of the river to avoid future tailings overflows. He judged that it would be less expensive to obtain additional easements, if necessary, on "this ranch and all the way down the river." Noble suggested that the easements should cover all the lands below the high water mark of the river.[46]

On March 15, 1912, Whitcraft and his wife Mary accepted a settlement for damage to the 96 acres identified by Noble as being in excess of the 1901 tailings easement. The settlement document, in addition to releasing the Anaconda Copper Mining Company from any past or future liability, also released companies acquired by Anaconda in 1910, including the Washoe Copper Company, the Butte and Boston Consolidated Mining Company, the Boston and Montana Consolidated Copper and Silver Mining Company, the Red Metals Mining Company, the Parrot Silver and Copper Company, the Colorado Smelting and Mining Company, and the Trenton Mining and Development Company.[47] Listing these additional companies was an indication that the damages claimed by Whitcraft were a result of not only tailings deposition from the Anaconda Reduction Works smelter, but also from the deposit of tailings in Silver Bow Creek by these other mining companies. Thus the Anaconda Copper Mining Company

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[45] F.C. Noble to William Wraith, September 15, 1911, Box 441, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[46] Ibid.

[47] "Agreement Between Edward and Mary Whitcraft and Anaconda Copper Mining Company et al.," March 15, 1912, Box 441, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

apparently realized that a portion of the tailings were deposited into Silver Bow Creek by its predecessors in interest.

Noble also investigated the claim of damages to the Henry Williams Ranch, which was located a short distance above the Whitcraft Ranch on Silver Bow Creek. Noble noted that deposition from tailings had occurred "for a period of years" before 1904, despite the fact that a "dyke" had been constructed "in the 90's" to prevent this overflow of tailings. According to Noble, the dike had been breached in 1910, causing additional deposition of tailings material from Silver Bow Creek. He assumed that the Anaconda Copper Mining Company would settle the damages caused by these tailings in a manner similar to its settlement with other affected ranchers.[48]

O.E. Meinzer, who investigated the water resources of the Butte area in 1912 for the United States Geological Survey (U.S.G.S.), reported on the extensive accumulation of tailings in the valley. He wrote that:

> ...along Silverbow Creek there are extensive deposits produced through the activities of man in the last two decades. Rapid aggradation has resulted along the Silverbow from the obstruction of the valley by slag dumps, bridges, and other structures and to a greater extent from the overloading of the stream with various mine wastes. West of Montana Street the slag from the old Butte Reduction Works forms across the valley a wall in which there is an artificial canyon 30 feet wide and 25 feet deep and farther downstream a tunnel through which the creek discharges. At the confluences of Blacktail and Silverbow creeks the muddy waters of the Silverbow have built a low but extensive delta fan, around the margin of which the clear waters of Blacktail Creek find their way.[49]

Precipitation continually washed residue from waste piles into Silver Bow Creek, but during spring runoff and whenever there were heavy rain storms, the deposition into the creek increased significantly. The waste material, laden with heavy metals, arsenic and other chemicals, was carried downstream and deposited on lands adjacent to the watercourse.

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[48] F.C. Noble to William Wraith, October 23, 1911, ACM Co. Papers, MS 169, Box 90, Folder 10, MHS.

[49] Meinzer, "The Water Resources Of Butte Montana", p. 86.

3.5 Warm Springs Creek and The Clark Fork River

During the eighteen years that the Anaconda Copper Mining Company operated the Upper and Lower Works at Anaconda and throughout most of the time that the company operated the Anaconda Reduction Works, it encountered problems in disposing of millions of tons of smelter tailings. The Anaconda Minerals Company (ARCO) estimated in 1987 that, between 1884 and 1901, the plants generated more than 14 million tons of waste.[50] During the first two decades of the 20^{th} century, a number of area ranchers filed suit against the Anaconda Copper Mining Company for damage to their lands caused by the deposition of these tailings downstream from Anaconda. In the course of responding to these complaints, company officials admitted their practice of disposing of tailings directly into Warm Springs Creek. Through their subsequent efforts to resolve litigation, the Anaconda Copper Mining Company also acknowledged that these tailings were being carried down Warm Springs Creek and the Clark Fork River and were being deposited on lands bordering those streams.

In 1905, Elizabeth Ann Staffanson sued the Anaconda Copper Mining Company claiming:

> That during a period of about ten years, immediately prior to the commencement of this action, the defendant has been operating a large concentrating and smelting plant near the said city of Anaconda, ... and in the operation of said plant the said defendant has concentrated, smelted and treated a large amount of ores and minerals, out of which a large amount of ores and tailings were wrongfully and unlawfully, carelessly and negligently permitted and allowed ... to become commingled with the waters of a certain stream ... designated as Warm Springs Creek.[51]

Staffanson argued that the company's policy of allowing smelter tailings to flow into Warm Springs Creek resulted in the "depositing [of] a large quantity of said waste, tailings and deleterious substances" on lands that she owned. These "deleterious substances ... were freed

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[50] Stephen E. Dole to Robert L. Duprey, February 9, 1987, EPA Administrative Record, File No. 208020/100004.

[51] *Elizabeth Ann Staffanson v. The Anaconda Copper Mining Company,* Docket #2390, District Court of the Third Judicial District, Deer Lodge County, Amended Complaint, Records of the District Court, Deer Lodge County Courthouse, Anaconda, Montana, p. 3.

from said waste and tailings, and penetrated and became intermingled with all of the soil" on lands that she claimed as being damaged.[52] As a result, Staffanson contended that she was not able to raise any crops on the land or use the land for pasture.[53]

The Anaconda Copper Mining Company responded to Staffanson's charges and admitted that the company had operated a smelter and concentrator near Anaconda for the ten years alleged in Staffanson's complaint. They also conceded that "large amounts of ores and tailings are carried away by that certain stream known and described as the Warm Springs Creek."[54] However, company officials denied that they had been negligent or careless in allowing the tailings to be carried away by the creek.

The company contended that the deposition of tailings did not cause any damage to Staffanson's land. Moreover, company officials stated that they and their predecessors in interest had located on Warm Springs Creek and acquired water rights prior to Staffanson locating on her land. Anaconda alleged "that use of such waters at all times necessarily impregnated the same with quantities of tailings and other substances, which have been precipitated and deposited by natural forces in the bed and upon the banks of said stream."[55] The company, in essence, claimed a prescriptive easement to continue depositing tailings in Warm Springs Creek. By its account, Anaconda had obtained the right when they purchased the assets and property of Anaconda Mining Company in 1895. This included the water rights of the predecessor company and therefore the right to "pollute the same as aforesaid, and to cause such tailings and refuse matter to be carried away and deposited as aforesaid ..."[56]

In the same year that Staffanson filed suit against the Anaconda Copper Mining Company, another local rancher, Henry Mason, whose land also was located on Warm Springs

[52] Ibid., p. 4.

[53] Ibid.

[54] *Staffanson v. Anaconda*, Docket #2390, Answer.

[55] Ibid., pp. 4-6.

[56] Ibid., p. 7. Note: The predecessor in interest referred to in the Anaconda Copper Mining Company's Answer was the Anaconda Mining Company. See Anaconda Copper Mining Company, Articles of Incorporation, Miscellaneous File #141, Silver Bow County Clerk and Recorder's Office, Silver Bow County Courthouse, Butte, Montana.

Creek, sued the company. Mason's accusations corresponded exactly to those presented by Staffanson. The company's answers to his complaint were exactly those used to refute Staffanson. In summary, the company admitted to the deposition of tailings as Mason alleged, denied that the action was damaging, and asserted that it had a prescriptive easement to continue to utilize water rights in the manner established by its predecessors in interest.[57]

In another, related case filed in 1902, Peter Valiton, a rancher who owned land on both sides of the Clark Fork (Deer Lodge) River in Powell County, accused the Anaconda Copper Mining Company of seriously damaging his lands by permitting smelter tailings to enter Warm Springs Creek and eventually the Clark Fork River. According to Valiton, the company had, for more than five years prior to the suit, "constructed and used for the purpose of carrying off and away from said smelting plant ... the tailings and other debris, down to and into ... the Deer Lodge (Clark Fork) River, a certain ditch, sluice or race way extending from the said smelting plant ..."[58]

Valiton alleged that the tailings poisoned, fouled, and polluted the river, which he used for irrigation. Thus, he contended that the use of water for irrigation poisoned his land and killed his crops. He also asserted that the heavy flow of tailings:

> ... were deposited in the natural channel of said river ... thereby causing the same to be raised and filled in places, with such debris and tailings, to such an extent, that ... the waters flowing in said Deer Lodge River overflowed the banks thereof and did carry and distribute ... large quantities of said debris and tailings over the lands of plaintiff ... and thereby ... injure and destroy the crops growing upon said lands ...[59]

Valiton claimed damages amounting to $50,000.[60]

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[57] *Henry Mason v. Anaconda Copper Mining Company,* Docket #2391, District Court of the Third Judicial District, Deer Lodge County, Records of the District Court, Deer Lodge County, Courthouse, Anaconda, Montana.

[58] *Peter Valiton v. Anaconda Copper Mining Company,* Docket #48, District Court of the Third Judicial District of the State of Montana, In and For the County of Powell, Amended Complaint, Records of the Powell County District Court, Powell County Courthouse, Deer Lodge, Montana, p. 4.

[59] Ibid., pp. 6-7.

[60] Ibid., pp. 12.

The Anaconda Copper Mining Company responded to Valiton in the same way that it did to other complainants. It denied that Valiton's water right predated the construction of the smelter in 1884. Company officials stated that their prescriptive easement allowed them to the use of the creek for disposal of tailings. Although they admitted polluting Warm Springs Creek and using the "sluice" mentioned in Valiton's complaint, they denied that the tailings deposition was significant or that the refuse and debris damaged the lands.[61]

Four farmers, with lands further north along the Clark Fork River (John Elison, Peter Normandi, Eli Dezourdis and John Hempstead), notified the Anaconda Copper Mining Company that tailings deposition on their lands had destroyed portions of their hay crop in 1908. The four farmers did not threaten legal action, but demanded payment for the losses to their crops.[62] The company directed F.C. Noble to investigate the claims of these individuals. It is clear from Noble's report of his survey of Dezourdis' land that the deposition in 1908 was not the first time that tailings had affected the lands in question. Noble indicated that portions of Dezourdis' damaged land that were located in Township 7 North, Range 9 West, Section 33, had been previously damaged by tailings deposition in 1903. He stated in his report that on the lands on the east side of the Clark Fork River:

> There are about 28-¾ acres of hay and pasture land ... which the survey of 1903 showed tailings and slum from a thin deposit near the outside line of the overflow to several inches in depth near the brush and river bank ... The high water of 1908 flowed over the same ground some two or three feet in depth and increased the outside limit of the high water deposit and made a new deposit of tailings.[63]

The Anaconda Copper Mining Company's claim in the above cases that the tailings did little or no damage, was refuted in an article published in 1908 by J.K. Haywood. Haywood studied the effects of smelter fumes and waste water from the Anaconda Reduction Works

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[61] *Valiton v. ACM Company,* Docket #48, Defendant's Answer to Plaintiff's Amended Complaint.

[62] Letter from unknown source to John Ryan, August 11, 1908, Box 441, Folder 8, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[63] F.C. Noble to J.A. Dunlap, September 14, 1908, Box 441, Folder 8, ACM Co. Papers, MHS Collection 169, Helena, Montana.

during part of 1906 and 1907. His work was prompted by the ongoing, smelter fume contamination suit against the company by the Deer Lodge Farmers Association. Haywood sampled waste water from the facility, as well as water from the Clark Fork River, and he also analyzed soil samples from lands in the Deer Lodge Valley.[64] Haywood concluded that "It is evident ... that the plant discharges large quantities of copper into the Deer Lodge River and that, even at a distance of 16 to 18 miles below the point where the tailings are discharged, a considerable quantity of copper is still present." He asserted that the high levels of copper in the water samples of the Clark Fork River indicated that the water from the river was unfit for irrigation use.[65]

Haywood's soil samples included samples from lands irrigated by the river and lands irrigated by other sources. He found only a "trace" of copper in soils irrigated by sources other than the Clark Fork River. However, the soil samples from lands irrigated by the river showed significant quantities of both soluble and insoluble copper. According to Haywood, when he first analyzed the samples taken in 1906, they revealed "such excessive amounts of copper" that he was unwilling to publish the results until he took new samples the following year. The copper content of the samples taken in 1907 differed with those taken in 1906, yet Haywood concluded that all of the soils irrigated by the Clark Fork River "contain very large quantities of copper, enough of which is present in a soluble form to be dangerous to, if not prohibitive of, many forms of plant growth."[66] Haywood's work on the waste water from the Anaconda Reduction Works clearly supported the contention of the farmers who filed suit or claimed damages from the company.

There is little information available concerning the company's method of dealing with the waste materials from the Anaconda Reduction Works prior to 1910. In a 1912 report on the

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[64] United States Department of Agriculture, Bureau of Chemistry, "First Investigation of Injury by Smelter Wastes Around Anaconda, Montana, 1906-1907" by J.K. Haywood in *Injury to Vegetation and Animal Life by Smelter Wastes,* Bulletin 113, pp. 21-36.

[65] Ibid, pp. 32, 33.

[66] Ibid, pp. 34-35.

projected life of the "slum fields," F.C. Noble suggested that it would be possible to extend the life of the fields by allowing:

> ... the slimes and other material to go over the spillway of the tailings dam in No. 1 Pond, and thence down to Deer Lodge River for uncertain periods during the year, (the present practice is that during five or six months of the year, most all the slums pass over this spillway).[67]

Noble asserted that, since the company had reached a settlement with 15 of the 20 ranchers between "French Crossing Ranch and Deer Lodge City which have on them tailings deposits from the river ...", it would be best to let these ranch lands "become a tailings and slum field whenever the river is high and will not carry the tailings."[68]

The litigation and tailings settlements were not viewed by the company as a critical problem. They had constructed six small slum ponds prior to 1910 but these ponds were unable to contain the volume of slimes and the overflow was "sluiced down the valley." An additional five tailings ponds were built in 1910 about 6 miles east of the smelter to catch the overflow.[69] Also, sometime prior to 1920, the company constructed a ditch that diverted water laden with mine and smelter waste from Silver Bow Creek to the settling ponds located northeast of the Anaconda Reduction Works. The point of diversion for the "Yellow Ditch" was one-half mile east of Gregson Hot Springs (Figure 3).[70]

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[67] F.C. Noble to William Wraith, February 1, 1912, Box 441, Folder 11, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[68] Ibid.

[69] William F. Flynn, "Report on Tailings Disposal at Anaconda Reduction Works," January 1937, Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 1.

[70] The name "Yellow Ditch" is derived from the 1961 United States Geological Survey (U.S.G.S.) topographic survey map for Anaconda, Montana. The topo indicates that the point of diversion of the ditch is in the NW¼ of Section 1, Township 3 North, Range 10 West. According to a March 23, 1938 map, "A.C.M. Co. Tailings Fields and Ditches," the "Yellow Ditch" was originally called the Silver Bow Creek Ditch. The map is included as Figure 1 in the following report: E.P. Dimock, "Report on Tailings Disposal at the Anaconda Reduction Works," February 20, 1947, Box 91, Folder 1, ACM Co. Papers, MHS Collection 169, Helena, Montana.

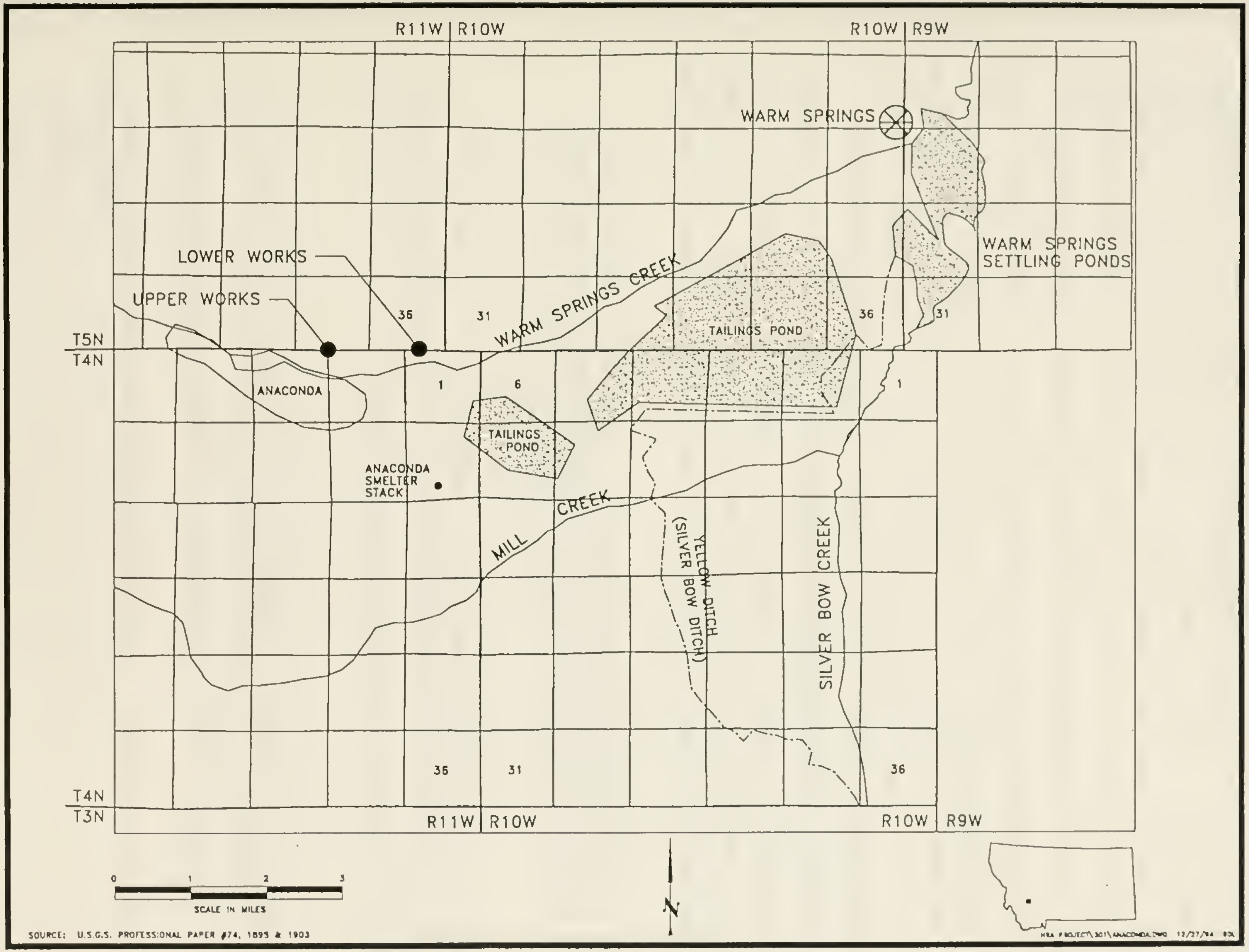

Figure 3. Anaconda Pond System and "Yellow Ditch."

These measures, however, did not prove wholly effective. According to a report prepared by W.C. Capron, the methods of disposing of tailings prior to 1917 were "totally inadequate to take care of their permanent impounding and prevent their getting into the Deer Lodge River."[71] Capron submitted his report, which included a brief account of the company's tailings disposal methods, on September 28, 1922. Two days later, Frederick Laist, manager of the Anaconda Reduction Department, informed C.F. Kelley, president of the Anaconda Copper Mining Company, that "one of the spillways on the Upper Warm Springs dam" had "washed out" the previous day. According to Laist, the "water in the upper pond emptied itself into the lower pond and overflowed the spillways ..."[72] The tailings that flowed over the spillways undoubtedly reached the Clark Fork River as a result of the washout.

In his 1937 report on the disposal of tailings at Anaconda, William F. Flynn detailed the construction of the several large tailings ponds in 1917 which, according to Flynn, were to "make a final settlement of the Anaconda Smelter tailings which might overflow from the upper ponds and also to settle the tailings in the Deer Lodge River."[73] Flynn added that the addition of the clarifying ponds eliminated the presence of solids in the tailings, but he stated that:

> There is an amount of iron which is in solution and which cannot be settled out in the ponds. This iron is precipitated out in the river bed below Warm Springs. The alkaline streams have a reaction on the river waters with the result that the iron is oxidized out of the water causing a reddish brown color.[74]

The historic record clearly indicates that the Anaconda Copper Mining Company disposed of smelter wastes from their Anaconda Reduction Works into Warm Springs Creek and the Clark Fork River. Area ranchers either sued the company for damages due to tailings

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[71] W.S. Capron, "Report on Tailings Disposal Plant at Opportunity and Clarifying Plant at Warm Springs," September 28, 1922, Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 1.

[72] Frederick Laist to C.F. Kelley, September 30, 1922, Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[73] Flynn, "Report on Tailings Disposal at Anaconda Reduction Works," ACM Co. Papers, MS 169, Box 90, Folder 10, MHS, p. 1.

[74] Ibid., p. 2.

deposition, or they agreed to a tailings settlement that allowed the company to continue depositing tailings wastes on their land forever. In their investigations of the methods of tailings disposal, company officials often warned that either the system was inadequate or provided information regarding past failures in the system.

3.6 The History of Specific Facilities in the Butte/Anaconda Area

◂ 3.6.1 Parrot Smelter

Location

The Parrot smelter was located on the northside of Silver Bow Creek in an area north of present-day Harrison Avenue. Its legal description is the SW¼ SE¼ of Section 18 and the NW¼ NE¼ of Section 19, Township 3 North, Range 7 West. The site is comprised of parts of Mineral Applications 956, 802, and 686 (see Figure 2).

Ownership

The Parrot Silver and Copper Company (the Parrot Company) was incorporated under the laws of Montana on August 16, 1880. Its officers were Franklin Farrell of Ansonia, Connecticut, president, S.T. Hauser of Helena, vice president, Thomas Wallace, secretary, and A.F. Migron of Torrington, Connecticut, agent. Farrell, Hauser and Migron purchased the Parrot mine in 1877, but waited three years for the coming of the railroad before developing the property. Migron purchased the site for the Parrot smelter in October 1880, and supervised the plant's construction.[75] Until its absorption by the Amalgamated Copper Company, the Parrot Company was run as a closed corporation under the direction of Farrell.[76]

The Amalgamated Copper Company, the Anaconda Copper Mining Company's holding company, purchased the majority of the Parrot Company's approximately $2,300,000 in stock

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[75] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 6.

[76] U.S.G.S., *Mineral Resources of the United States; Calendar Year 1891*, (Washington: GPO, 1893), p. 97.

in 1899.[77] During that same year the Parrot smelter was closed permanently.[78] On May 31, 1910, the Anaconda Copper Mining Company acquired all of the real and personal property of the Parrot Silver and Copper Company in exchange for Anaconda stock.[79] In this acquisition, the Anaconda Copper Mining Company agreed to:

> carry out and fully perform and discharge all contracts, obligations and liabilities, of every kind, character and description, whether in contract or in tort, and whether now or hereafter enforceable against the first party, and to undertake to and fully carry out and completely perform, all valid executory provisions of any contract or contracts which may exist at the date of the transfer and delivery of all of the property and assets of the said first party to the said second party.[80]

Duration and Type of Operation

The Parrot smelter was the largest in Butte, a giant compared to the other Butte mills. The smelter began production in July 1881 and ceased operations on August 29, 1899. It milled the rich copper ores of the Parrot lode, including ore from the Parrot, Little Minah, Bellona and Original No. 6 mines.[81] The Parrot was the first smelter in the United States to use the Bessemer process, which converted 50 to 60% copper matte to 97% black copper. The product was then shipped to the Parrot Company's Works at Bridgeport, Connecticut, where the gold and silver were extracted and the copper was refined by electro-deposition.[82]

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[77] U.S.G.S., *21st Annual Report, 1899-1900, Part VI, Mineral Resources of the United States, 1899, Metallic Products, Coal and Coke*, (Washington: GPO, 1901), p. 184.

[78] H.O. Hofman, "Metallurgy of Copper," *Transactions of the American Institute of Mining Engineers*, vol. 34, (New York: The Institute, 1904), p. 262.

[79] Deed Book 98, Silver Bow County Clerk and Recorder's Office, Silver Bow County Courthouse, Butte, Montana, p. 135.

[80] Indenture, Parrot Silver and Copper Company to Anaconda Copper Mining Company, May 31, 1910.

[81] Hofman, "Metallurgy of Copper," p. 262; Horace J. Stevens, editor and compiler, *The Copper Handbook*, vol. 8, (Houghton, Michigan: Horace J. Stevens, 1908), p. 1104.

[82] Hofman, "Metallurgy of Copper," pp. 260-262; James Douglas, "Summary of American Improvements and Inventions in Ore-Crushing and Concentration, and in the Metallurgy of Copper, Lead, Gold, Silver, Nickel, Aluminum, Zinc, Mercury, Antimony and Tin," *Transactions of the American Institute of Mining Engineers*, vol. 22, 1894, p. 334.

In 1886 the smelter included 12 large calcining furnaces, six reverberatory matting furnaces, one 80-ton blast furnace, one small copula and six Manhes converters. Later, two giant Keller-Cole-Gaylord furnaces were installed with a capacity of 50 tons each, and one O'Hara furnace that treated 50 tons of concentrated ore per day. When the plant closed in 1899, it was smelting 135 tons of ore per day in three reverberatory furnaces and 240 additional tons per day in two blast furnaces.[83]

The Parrot Company completed construction of its concentrating mill for the smelter in April 1882. It equipped the 50-ton concentrator with a Blake crusher, Harz jigs and Frue vanners. The following year, the company added jigs to handle the fine sand that originally had gone to the vanners and, in 1884, introduced Rittinger tables. The mill's capacity increased from 50 tons per day in 1882 to 200 tons in 1884, and reached 225 to 300 tons in 1891.[84] By 1896, the concentration process was producing 23 tons of slimes per day. The slimes constituted the overflow from pulp which had passed through a 1/24th-inch sieve and failed to separate out on the vanners. About 65% of the slimes were returned to the vanners, while the remaining 35% was dumped in slime pits next to Silver Bow Creek. This waste was a source of material that eventually washed down Silver Bow Creek to the Clark Fork River. The composition of the slimes assayed in 1896 was 7.3% copper, 6.6% iron, 9.6% sulphur and 74.6% silica.[85]

Table 1 presents the production statistics of the Parrot Smelter.

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[83] U.S.G.S., *Mineral Resources of the United States; Calendar Year 1885*, (Washington: GPO, 1886), p. 216; Hofman, "Metallurgy of Copper," p. 262.

[84] Charles W. Goodale, "Concentration of Ores in the Butte District, Montana," *Transactions of the American Institute of Mining Engineers*, vol. 26, 1896, p. 601; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1891*, p. 97.

[85] U.S.G.S., "The Mines and Reduction Works of Butte City, Montana," in *Mineral Resources of the United States; Calendar Years 1883 and 1884*, (Washington: GPO, 1885), p. 385; Goodale, "Concentration of Ores in the Butte District, Montana," pp. 601-602.

Table 1. Production Figures for the Parrot Smelter.

YEAR	POUNDS OF COPPER	YEAR	POUNDS OF COPPER
1881	not available	1891	not available
1882	not available	1892	12,438,782 [2]
1883	not available	1893	7,791,167 [3]
1884	9,300,000 [1]	1894	7,469,908 [3]
1885	9,809,000 [1]	1895	7,257,000 [3]
1886	10,000,000 [1]	1896	8,045,648 [3]
1887	10,000,000 [1]	1897	14,824,487 [4]
1888	10,750,000 [1]	1898	12,444,828 [4]
1889	9,500,000 [1]	1899	10,625,696 [4]
1890	9,000,000 [1]		

[1] James Douglas, "Copper Resources of the United States," *Transactions of the American Institute of Mining Engineers*, vol. 19, 1891, p. 703.
[2] Robert George Raymer, M.A., *Montana: The Land and the People*, vol. 1, The Lewis Publishing Company, Chicago, & New York, 1930, p. 450.
[3] Richard P. Rothwell, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1899*, vol. 8, Scientific Publishing Company, New York & London, 1900, p. 164.
[4] Joseph Struthers, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1902*, vol. 11, 1903, p. 169.

Deposition of Hazardous Substances Into Silver Bow Creek

The concentrator plant produced most of the Parrot tailings. Ore passed over the jig tables and the sand tailings from the jigs were conveyed by a launder to the tailings dump adjoining the works. These tailings in 1896 reportedly contained 1.5% copper, which could, if reduced, amount to about 2,640 pounds of copper per day.[86] During its last year of operation, the plant processed a portion of the accumulated tailings.[87] After the plant closed in 1899, attempts were made to extract copper from the slag and tailings dump by precipitation.[88]

In 1920 the Anaconda Copper Mining Company assayed the Parrot tailings, which were estimated to contain about 269,000 dry tons. The Timber Butte Milling Company, which had

[86] Goodale, "Concentration of Ores in the Butte District, Montana," p. 602, 617.

[87] Walker, "Copper Mines of Butte," p. 22.

[88] Stevens, ed., *Copper Handbook*, vol. 8, p. 1104.

approached the Anaconda Copper Mining Company with a proposal to treat both the Parrot and Colorado tailings, described a large part of the tailings as lying "under water."[89] It was these wastes that were eventually deposited downstream in Silver Bow Creek. Between 1922 and 1926, 25,980 wet tons containing about 30.80% water and an average of 3.5% copper, were shipped to the Anaconda Reduction Works.[90]

The Anaconda Copper Mining Company assayed the slime bed again in 1942. The slimes had been deposited with interbedded layers of sand tailings and were mostly covered by a layer of barren ochre, with leached sand tailings up to 15 feet thick covering the rest. Situated beside Silver Bow Creek the slimes were estimated to contain 30% water. The total tonnage was estimated at 50,089 wet tons, or 35,062 dry tons. The slime bed averaged 4.3 feet thick with 2.71% copper content. The top 20% of the bed had oxidized.[91]

◂ 3.6.2 Butte Reduction Works

Location

The Butte Reduction Works were located on the southside of Silver Bow Creek just west of present-day Montana Street. The legal description of the site is the N½ SW¼ of Section 24 in Township 3 North, Range 8 West. The site's location includes Mineral Application No. 720 and two placers, the Silas F. King Placer and the Smelter Placer (see Figure 2).

[89] W.N. Rossberg to William A. Clark, Jr., March 15, 1920; Selden S. Rodgers to Frederick Laist, July 20, 1920 both in Box 63, Folder 13, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[90] J.M. Gillie to F.A. Linforth, November 6, 1941, Box 65, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[91] C.H. Steele, "Report on Slimes from Early Day Concentrators Located at Butte, Montana," February 1943, Box 66, Folder 5, ACM Co. Papers, MHS Collection 169, Helena, Montana, pp. 1-2, 6-7, 9.

Ownership

The Orford Copper and Sulphur Company constructed the Butte Reduction Works in 1883.[92] Soon thereafter, several individuals, James McArthur, Larry Muldoon, Rudolph Siever, John and William Schaunburger, and David Murphy, initiated custom smelting operations at the works. The plant was not successful financially and the employees of the Parrot smelter took over operations of the Butte Reduction facility. W.A. Clark bought the smelter in 1887.[93]

In 1897, the works became the property of Clark's Colusa-Parrot Mining and Smelting Company and the Butte Reduction Works treated ore from all of Clark's mines, most of which belonged to his Original Consolidated Mining Company. Clark served as president of both companies.[94] On May 31, 1910, Clark sold the Butte Reduction Works to the Anaconda Copper Mining Company, and the plant was closed.[95]

Wastes from the Butte Reduction Works were deposited in dumps located on the Smelter Placer, which was situated between the Works and Silver Bow Creek. The Colorado Smelting and Mining Company owned the Smelter Placer from June 5, 1891 until January 4, 1904, when it was conveyed to the Trenton Mining and Development Company. The Trenton Company owned the placer until May 31, 1910, when it conveyed it to the Anaconda Copper Mining Company.[96]

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[92] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8; "Copper Mines of Butte, Montana," in *Engineering and Mining Journal*, vol. 41, April 24, 1886, p. 299.

[93] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8.

[94] Stevens, ed., *The Copper Handbook*, vol. 8, pp. 546 and 1083.

[95] Deed Book 98, Office of Silver Bow County Clerk and Recorder, Silver Bow County Courthouse, Butte, Montana, pp. 333-335; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1910*, (Washington: GPO, 1911), p. 201. Also see Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8. Smith states, "The concentrator part of the plant was leased back to W.A. Clark, who used it for concentrating zinc ore from the Elm Orlu Mine." The plant was destroyed by fire on October 24, 1911. But no corroborating evidence of the plant's lease has been found.

[96] Indenture, Colorado Smelting and Mining Company and Trenton Mining and Development Company, January 4, 1904, Deed Book 66, pp. 164-171; Indenture, Trenton Mining and Development Company and Anaconda Copper Mining Company, May 31, 1910, Deed Book 98, pp. 142-151, Silver Bow County Clerk and Recorder's Office, Silver Bow County Courthouse, Butte, Montana.

Duration and Type of Operation

When the Orford Copper and Sulphur Company constructed the Butte Reduction Works in 1883, it smelted low grade copper pyrites from the Clear Grit mine.[97] Copper operations continued at the site under different owners until 1910.[98] During the initial operations of the smelter, ore was roasted in heaps and smelted in a 36" waterjacket blast furnace. By 1888, the plant had two hand-reverberatory furnaces and a Bruckner cylinder. These were replaced during the 1890s by Wethey calcining furnaces and the works had a capacity of 400 tons per day by 1896.[99] During 1905 and 1906, the works were overhauled at a cost of $300,000. They were partially destroyed by fire in 1906 and thoroughly rebuilt. In 1907, the smelter had five Wethey and two McDougall calciners, two 150-ton blast furnaces and three 80-ton reverberatories. The total capacity of the furnaces equalled 540 tons.[100]

In 1889, the concentrator of the Butte Reduction Works used steam-stamps, hydraulic separators or classifiers, Collom jigs and revolving slime tables. The steam-stamps represented a newer, cheaper process than that of the crushers and Cornish rolls employed in most other Butte concentrators, but they required more water (about 5,000 gallons per ton of crude ore) and they produced a higher percentage of slimes. The steam-stamps were replaced by a Blake crusher and nine Cornish rolls in 1906. Its capacity rose from 200 tons per day in 1889, to 1,000 tons by 1907, when it was concentrating four tons into one.[101] In that year, a 700-ton

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[97] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8; *Engineering and Mining Journal*, vol. 41, April 24, 1886, p. 299.

[98] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8.

[99] Hofman, "Notes on the Metallurgy of Copper," pp. 262-263; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1896*, (Washington: GPO, 1897), p. 205.

[100] Stevens, ed., *The Copper Handbook*, vol. 8, 1908, p. 546; U.S.G.S., *Mineral Resources of the United States, Calendar Year 1907*, (Washington: GPO, 1908), pp. 335-336. The *Mineral Resources, 1907* described the capacity of the smelter in comparison to the concentrator as follows: "A 700-ton concentrator was built ... the whole capacity of the concentrator is now 1,200 tons in 24 hours, or about equal to that of the smelters."

[101] Goodale, "Concentration of Ores in the Butte District, Montana," pp. 600, 607-608, 613-614; Horace J. Stevens, editor and compiler, *The Copper Handbook*, vol. 6, (Houghton, Michigan: Horace J. Stevens, 1906), pp. 381-382; Stevens, ed., *The Copper Handbook*, vol. 8, p. 546.

concentrator and 10 Harz jigs, equivalent to 50 of the old type, were added and the capacity was increased to 1,200 tons daily.[102]

Following its purchase in 1910 by the Anaconda Copper Mining Company, the plant was closed, and in 1911 a fire destroyed the facility.[103] In 1927, it was reconstructed for calcining and nodulizing manganese ore, and opened March 15, 1928. The Anaconda Copper Mining Company leased the plant to the Domestic Manganese and Development Company, which had incorporated in Montana in 1927. The company contracted with the Anaconda Company in 1928 for delivery of manganese ore over the next five years. The reconstructed plant had a capacity of 300 tons per day.[104]

Table 2 provides production statistics for the Butte Reduction Works.

Deposition of Hazardous Substances Into Silver Bow Creek

Wastes from the Butte Reduction Works were deposited in tailings dumps located on the Smelter Placer, which straddle Silver Bow Creek.[105] As noted above, the Colorado Smelting and Mining Company transferred its interest in the Smelter Placer to the Trenton Mining and Development Company, which subsequently conveyed all of its interests to the Anaconda Copper Mining Company on May 31, 1910.

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[102] U.S.G.S., *Mineral Resources of the United States; Calendar Year 1907*, pp. 335-336. According to this document, Silver Bow Creek ran through the Butte Reduction Works, since a "twelve hundred feet of 8 by 16 foot reinforced concrete culvert was built to preserve the channel of Silver Bow Creek through the works."

[103] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8.

[104] Lenox H. Rand and Edward B. Sturgis, eds., *The Mines Handbook, Succeeding the Copper Handbook, 1931*, vol. 18, (New York: Mines Information Bureau, 1931), p. 1304.

[105] Harper, MacDonald & Co., "Map of Mining Claims, Butte & Vicinity, Montana," compiled and published by Harper, MacDonald & Co., Butte, Montana, 1907, Map Collection, D-13, MHS, Helena, Montana.

Table 2. Production Figures for Butte Reduction Works.

YEAR	POUNDS OF COPPER	YEAR	POUNDS OF COPPER
1883	not available	1897	7,883,795 [4]
1884	2,000,000 [1]	1898	9,685,088 [4]
1885	2,500,000 [2]	1899	10,049,629 [4]
1886	1,700,000 [1]	1900	12,455,772 [4]
1887	1,565,000 [1]	1901	17,969,663 [4]
1888	3,521,556 [1]	1902	19,400,000 (estimated) [4]
1889	2,560,000 [2]	1903	not available
1890	3,300,000 [1]	1904	not available
1891	not available	1905	not available
1892	2,864,000 [2]	1906	not available
1893	2,985,485 [3]	1907	not available
1894	2,282,000 [3]	1908	not available
1895	3,390,000 [3]	1909	not available
1896	4,225,647 [4]	1910	not available

[1] James Douglas, "Copper Resources of the United States," *Transactions of the American Institute of Mining Engineers*, vol. 19, 1891, p. 703.
[2] Robert George Raymer, M.A., *Montana: The Land and the People*, vol. 1, The Lewis Publishing Company, Chicago, & New York, 1930, p. 450.
[3] Richard P. Rothwell, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1899*, vol. 8, Scientific Publishing Company, New York & London, 1900, p. 164.
[4] Joseph Struthers, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1902*, vol. 11, 1903, p. 169.

◂ 3.6.3 Colorado Smelter

Location

The Colorado and Montana Smelting Company smelter was located on the southside of Silver Bow Creek about 1.5 miles west of the junction of the creek and Montana Street. The legal description of the site is the S½ SE¼ of Section 23, Township 3 North, Range 8 West. The location of the tailings associated with the smelter encompasses parts of Mineral Application No. 944 (the Gold Stream Lode, the Colorado Placer and the Jump Up Lode) and Mineral Application No. 927 (the Schmidt Placer and the Gamer Placer) [see Figure 2].

Ownership

The Boston and Colorado Smelting Company of Black Hawk, Colorado sent its representative Henry Williams to Butte in 1878 to investigate the viability of a custom smelter. When Williams reported back favorably, the company proceeded with plans to construct a facility. It first acquired the site where R.K. Williams had operated a small, unsuccessful smelter, dismantled the old plant, and began construction of its own smelter. With the new smelter operating, on December 21, 1879, N.P. Hill and W.A. Clark organized the Colorado Mining and Smelting Company under the laws of Colorado. Hill served as president, and Clark as vice president.[106]

The Amalgamated Copper Company, the Anaconda Copper Mining Company's holding company, purchased the stock of the Colorado Mining and Smelting Company in 1899.[107] In 1904, the company's $2,500,000 capital stock was "entirely owned, except founders' shares, by the Amalgamated Copper Co."[108] When the Colorado Mining and Smelting Company's charter expired in 1903, it was reorganized as the Trenton Mining and Development Company.[109] Amalgamated owned all of the Trenton Mining and Development Company stock. Anaconda Copper Mining Company president John D. Ryan served as the new company's director and John Gillie as its superintendent.[110]

By an Agreement dated May 26, 1910, the Anaconda Copper Mining Company acquired the Trenton Mining and Development Company for 120,000 shares of Anaconda stock, and the former company dissolved. In this acquisition, the Anaconda Copper Mining Company agreed:

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[106] Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 5-6.

[107] U.S.G.S., *21st Annual Report, 1899-1900, Part VI, Mineral Resources of the United States, 1899, Metallic Products, Coal and Coke*, (Washington: GPO, 1901), p. 184.

[108] Horace J. Stevens, editor and compiler, *The Copper Handbook*, vol. 5 for the year 1904, (Houghton: Michigan: Horace J. Stevens, 1905), p. 328.

[109] "Minutes of the First Meeting of Directors," Trenton Mining and Development Company, December 28, 1903, EPA Document Response to 104E Request, ARCO.

[110] Stevens, ed., *The Copper Handbook*, vol. 8, pp. 1331-1332.

> to carry out and fully perform and discharge all contracts, obligations and liabilities, of every kind, character and description, whether in contract or in tort, and whether now or hereafter enforceable against the second party, and to undertake to and fully carry out and completely perform, all valid executory provisions of any contract or contracts which may exist at the date of the transfer and delivery of all of the property and assets of the said second party to the said second party.[111]

Duration and Type of Operation

Henry Williams, who the Colorado and Montana Smelting Company would name as manager of the new plant, completed the construction of the Colorado Smelter in 1879. Originally the owners leased three mining claims, the Fredonia, Nettie and Selfrising claims, to maintain a supply of ore for their smelter. Soon, however, the smelter was conducting mainly a custom business, treating copper ore that was particularly rich in silver. It produced a high grade argentiferous matte which it shipped to the Argo works of the Boston and Colorado Smelting Company for refining.[112] The Colorado and Montana Smelting Company continued to operate its smelter until 1905.[113]

Initially the plant roasted ore in a long-hearth hand reverberatory furnace and smelted it in a reverberatory matting-furnace with wood fuel, treating 12 tons of ore per day and producing 60% copper matte with 700 to 800 oz. silver per ton. In 1889, the matting furnace was enlarged to handle 18 tons of ore per day, and in the 1890s R. Pearce turret furnaces were added to the roasting department. The smelter comprised 10 turret furnaces and 3 large matting-reverberatories in 1902.[114]

The Colorado and Montana Smelting Company encountered special problems in concentrating and extracting silver from the slimes, since it mainly worked silver and silver-copper ores that were highly siliceous. Erected in 1882, its concentrator was equipped with a crusher, Cornish rolls, sizing screens and Harz jigs. The original two round tables

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[111] Agreement, Anaconda Copper Mining Company and Trenton Mining and Development Company, May 26, 1910, EPA Administrative Record, File No. 4010603/420328.

[112] Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 6; U.S.G.S., *Mineral Resources of the United States; Calendar Years 1883 and 1884*, (Washington: GPO, 1885), p. 340.

[113] Stevens, ed., *The Copper Handbook*, vol. 8, p. 1332.

[114] Hofman, "Notes on the Metallurgy of Copper," pp. 259-260.

proved inadequate. Experimentation with a Hooper slimer in 1886 was no more successful and finally Frue vanners were introduced. In 1896, a run of 1,976 tons of Parrot ore produced about 11 tons of slimes assayed as 9.2 oz. silver and 10.5% copper. These sticky slimes were allowed to overflow the vanners into a large tank, "as no machine could handle it to advantage."[115] The concentrator required about 300 gallons of water per minute, or about 5,000 gallons per ton of ore. Its original capacity of 50 tons per day was enlarged to 300 by 1896.[116]

When the Colorado smelter closed permanently in 1905, the company shipped its ores to the Anaconda Reduction Works in Anaconda for smelting. Although it was reported as late as 1907 that the Trenton Mining and Development Company held the Colorado Smelter in reserve for emergencies, there is no indication that the company used the facility again.[117]

Table 3 reports the production statistics of the Colorado smelter.

Deposition of Hazardous Substances Into Silver Bow Creek

The Anaconda Copper Mining Company assayed the Colorado tailings dump in 1920 in response to the Timber Butte Mining Company's offer to treat tailings at its facility. The Anaconda Company estimated that the tailings contained 314,000 dry tons, bearing .78% copper and 2.18 oz. silver per ton. Timber Butte Milling Company's assay of the dump estimated it to be just 211,000 tons "above water level."[118] The manager of Timber Butte Milling Company acknowledged that tonnage estimates were unreliable because "a large portion of the tailings lie under water."[119] It was these wastes that were eventually deposited downstream. Bayard S. Morrow, the Superintendent of Concentration for the Anaconda Copper Mining

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[115] Goodale, "Concentration of Ores in the Butte District, Montana," pp. 605-606.

[116] Ibid., pp. 602-606, 619-620.

[117] Stevens, ed., *The Copper Handbook*, vol. 8, p. 1332.

[118] Seldon S. Rodgers to Frederick Laist, July 20, 1920, and Bayard S. Morrow to Frederick Laist, March 23, 1920, Box 63, Folder 13, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[119] W.N. Rossberg to John Gillie, March 15, 1920, Box 63, Folder 13, ACM Co. Papers, MHS Collection 169, Helena, Montana.

Company, recommended to the company that the dumps be treated at the Anaconda Reduction Works rather than at the Timber Butte Milling Company.[120]

Table 3. Production Figures for the Colorado Smelter.

YEAR	POUNDS OF COPPER	YEAR	POUNDS OF COPPER
1879	not available	1892	4,560,972 [2]
1880	not available	1893	6,703,488 [3]
1881	not available	1894	5,158,730 [3]
1882	not available	1895	7,750,000 [3]
1883	not available	1896	9,090,680 [4]
1884	not available	1897	8,911,578 [4]
1885	1,200,000 [2]	1898	7,657,938 [4]
1886	2,000,000 [1]	1899	9,572,155 [4]
1887	1,500,000 [1]	1900	11,453,940 [4]
1888	1,488,000 [1]	1901	7,465,260 (estimated) [4]
1889	2,954,000 [2]	1902	10,000,000 (estimated) [4]
1889	2,951,000 [1]	1903	not available
1890	2,320,000 [1]	1904	not available
1891	not available	1905	not available

[1] James Douglas, "Copper Resources of the United States," *Transactions of the American Institute of Mining Engineers*, vol. 19, 1891, p. 703.
[2] Robert George Raymer, M.A., *Montana: The Land and the People*, vol. 1, The Lewis Publishing Company, Chicago, & New York, 1930, p. 450.
[3] Richard P. Rothwell, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1899*, vol. 8, Scientific Publishing Company, New York & London, 1900, p. 164.
[4] Joseph Struthers, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1902*, vol. 11, 1903, p. 169.

The Anaconda Copper Mining Company assayed the Colorado smelter's slime bed again in 1942. At that time, the bed was described as lying along the south bank of Silver Bow Creek, around and possibly under the northwest rim of "a large leached sand tailings area" by the old smelter site. The slimes were estimated to contain 30% water. The total tonnage was estimated at 44,491 wet tons, or 31,144 dry tons, averaging 3.6 feet thick with 1.64% copper content and 1.92 oz. silver per ton. The core samples showed varying amounts of leached

[120] Bayard S. Morrow to Frederick Laist, March 23, 1920, Box 63, Folder 13, ACM Co. Papers, MHS Collection 169, Helena, Montana.

slimes and sand, while roughly the center third of the slime bed was completely leached out and not calculated into the tonnage estimates.[121]

◂ 3.6.4 Old Works / East Anaconda & Smelter Hill

Location

The Upper Works and Lower Works — known collectively as the "Old Works" — were located on the north side of Warm Springs Creek, just north of Anaconda. The legal description of the site is the S½S½ of Section 35 and the S½S½ of Section 36 in Township 5 North, Range 11 West and the NE¼NE¼ of Section 3, the N½N½ of Section 2 and N½N½ of Section 1 in Township 4 North, Range 11 West (see Figure 3).

Ownership

Marcus Daly initiated construction of the Upper Works in 1883. Five years later, in 1888, Daly directed construction of the Lower Works plant.[122] The Anaconda Mining Company acquired the two plants in 1891 soon after its incorporation.[123] The company owned the plants until June 15, 1895, when it transferred all its assets to the Anaconda Copper Mining Company.[124]

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[121] C.H. Steele, "Report of Slimes from Early Day Concentrators Located at Butte, Montana," February 1943, Box 66, Folder 5, ACM Co. Papers, MHS Collection 169, Helena, Montana, pp. 1-2, 7-10.

[122] Raymer, *Montana: The Land and the People,* vol. 1, pp. 447-449; Goodale, "Concentration of Ores in the Butte District, Montana," p. 609; Smith, *History of the Early Reduction Plants of Butte, Montana,* pp. 7-8, 12. According to Raymer, by 1881 Marcus Daly was acting as a representative of the Anaconda Silver Mining Company in developing the Anaconda mine and the smelting operations for the mine's ore.

[123] Jess Monk, compiler, "Chronological History of the Old Reduction Works," June, 1958, Box 132, File 132-7, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[124] Deed Book 28, Deer Lodge County Clerk and Recorder's Office, Deer Lodge County Courthouse, Anaconda, Montana, pp. 448-449.

The Amalgamated Copper Company acquired a majority of the Anaconda Copper Mining Company's $30,000,000 capital stock in 1899. Plans were soon underway for construction of a huge new plant at Anaconda to replace the Old Reduction Works.[125]

Duration and Type of Operation

Marcus Daly chose the site for the Anaconda smelter on Warm Springs Creek, 26 miles by rail from the Anaconda mine, for the abundant water supply that Warm Springs Creek would provide. By September 1884, the Upper Works facility was ready to begin production.[126] Daly opened the second of the two plants, the Lower Works, in December 1888. A fire in 1889 partially destroyed the wooden Lower Works, and Daly rebuilt the smelter with steel construction. The Anaconda Mining Company continued to expand the two facilities following its acquisition of the two plants in 1891. In 1901, six years after the Anaconda Copper Mining Company acquired the Upper and Lower Works, it dismantled the facilities and proceeded with the construction of the Anaconda Reduction Works.[127]

When the Upper Works began smelting operations in 1884, it was equipped with 26 calciners, 26 small matting-furnaces, and 12 hand roasting furnaces. By 1891, Daly replaced the hand roasters with Bruckner cylinders and constructed a second smelter.[128] The first concentrator for the Upper Works included 12 sets of rolls and 72 jigs and had a capacity of 400 to 500 tons per day.[129] Vanners, installed later, processed the slime waste. Otto Stahlmann, under Daly's direction, overhauled the Upper Works concentrator in 1886. He

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[125] U.S.G.S., *21st Annual Report, 1899-1900, Part VI, Mineral Resources of the United States, 1899, Metallic Products, Coal and Coke*, p. 184.

[126] Raymer, *Montana: The Land and the People*, vol. 1, pp. 447-449; Goodale, "Concentration of Ores in the Butte District, Montana," p. 609; Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 7-8.

[127] Hofman, "Notes on the Metallurgy of Copper," p. 266; Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 12-13.

[128] U.S.G.S., *Mineral Resources of the United States; Calendar Years 1883 & 1884*, (Washington: GPO, 1885), pp. 338-339; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1891*, (Washington: GPO, 1893), p. 92; Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 12.

[129] U.S.G.S., *Mineral Resources of the United States; Calendar Years 1883 & 1884*, p. 338; Smith, *History of the Early Reduction Plants of Butte, Montana*, p. 8.

installed steam-stamps, Collom jigs, hydraulic separators and circular slime-tables and increased the capacity of the mill to 2,000 tons per day. When Daly and Stahlmann determined that the steam-stamps produced too large a percentage of slimes from fine ore, they replaced them with crushers and rollers.[130]

The Lower Works, erected in 1888 by Stahlmann, contained one smelting plant with 56 Bruckner cylinders and 28 matting-furnaces, as well as its own concentrator. By 1890 Stahlmann had added another 40 Bruckner cylinders, similar in size to the original 56 cylinders, to the smelter. The smelting facility underwent additional improvements in 1899 when four MacDougall furnaces were installed and seven of the original 28 matting-furnaces were enlarged. The concentrator for the Lower Works in 1891 was equipped with eight Ball Stamps, together with the required washing machinery, and had an approximate, daily capacity of 2,000 tons.[131]

In addition to the smelting plants and concentrators of the Upper and Lower Works, the Anaconda facility included a converter plant and an electrolytic refining plant. The converter plant was first installed in 1890 and consisted of 12 to 15 upright converters. The convertors were contained in the same building with the six blast furnaces used to melt matte from the two plants. In 1891 the converter plant Bessermized 60 tons of blister copper per day, while the electrolytic plant, operating in an experimental capacity, produced 20 tons per day of electrolytic copper.[132]

Table 4 combines the production statistics for the Upper and Lower Works.

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[130] Goodale, "Concentration of Ores in the Butte District, Montana," pp. 609-610; Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 8, 12-13.

[131] Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 12-13; Hofman, "Notes on the Metallurgy of Copper," p. 266; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1891*, (Washington: GPO, 1893), p. 92.

[132] Smith, *History of the Early Reduction Plants of Butte, Montana*, pp. 12-13; Hofman, "Notes on the Metallurgy of Copper," p. 266; U.S.G.S., *Mineral Resources of the United States; Calendar Year 1891*, p. 92.

Table 4. Production Figures for the Upper and Lower Works.

YEAR	POUNDS OF COPPER	YEAR	POUNDS OF COPPER
1884	23,000,000 [1]	1893	75,256,657 [2]
1885	36,000,000 [1]	1894	95,578,000 [2]
1886	33,267,864 [1]	1895	99,775,294 [2]
1887	57,000,000 [1]	1896	125,350,693 [2]
1888	63,245,473 [1]	1897	131,471,127 [3]
1889	61,647,000 [1]	1898	107,214,059 [3]
1890	64,046,812 [1]	1899	107,914,357 [3]
1891	not available	1901	101,850,224 (estimated) [3]
1892	100,000,000 [2]	1902	75,000,000 (estimated) [3]

[1] James Douglas, "Copper Resources of the United States," *Transactions of the American Institute of Mining Engineers*, vol. 19, 1891, p. 703.
[2] Richard P. Rothwell, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1899*, vol. 8, Scientific Publishing Company, New York & London, 1900, p. 164.
[3] Joseph Struthers, ed., *The Mineral Industry, its Statistics, Technology and Trade in the United States and Other Countries to the End of 1902*, vol. 11, 1903, p. 169.

Deposition of Hazardous Substances Into Warm Springs Creek

The Lower Works tailings dump fanned out from the south bank of Warm Springs Creek, across the creek from the plant. This was a source of waste material that found its way into the creek and downstream to the Clark Fork River. Between 1887 and 1902, "jig and table tailings, reverberatory slag, ashes and cinders were delivered to the apex of the dump more or less indiscriminately." They formed an "inconspicuous low mound of tailing material extending over some 120 acres."[133]

Around 1912, the company attempted to leach copper from the abandoned dump. Timbered horizontal troughs, measuring 5,600 feet in length, and six shafts were driven into the tailings pile. Water was poured over the surface and allowed to percolate down to a harder substratum, where the copper water was deflected to a centralized point. The leaching scheme was ineffective and soon abandoned. About 12,800,000 pounds of copper was leached out, but

[133] "Anaconda Copper Mining Company, Reductions Department Research Department, Old Work Tailings," February 21, 1938, Box 65, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, map and p. 3; "Report on Sampling and Metallurgical Investigation of the Lower Old Works Tailings Dump," 1938, Box 65, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. "A".

only 10% was recovered, while "probably more than 15% (was) lost by seepage through the gravel bottom."[134]

An assay of the dump by the Anaconda Copper Mining Company in 1938 revealed the top 5 feet was "decidedly oxidized," while underneath the crust there had been "surprisingly little" oxidation. Though about 2/3 of the copper content had leached out, the dump contained about 2,088,000 tons of material that could be profitably reclaimed, containing 1.25% copper and .38% copper-oxide.[135] It was this tailings dump that was a source for some of the substances entering Warm Springs Creek.

Anaconda Operable Units

Waste water proved a significant problem for the Anaconda Copper Mining Company's smelter at Anaconda since the start of operations during the mid-1880s. The history of these units (Anaconda Regional Water and Waste Operable Unit and Anaconda Soils Operable) is discussed generally above. In summary, the Anaconda Company was forced to construct numerous settling ponds after 1900 to hold released water. The ponds were rarely adequate and were either breached or overflowed during periods of high water. The Anaconda Copper Mining Company sought to expand the waste water treatment facilities with addition of new and larger pond system in the late 1940s.

The Anaconda Copper Mining Company also had to contend with the contamination of soils at the Anaconda smelter and the surrounding area. The company faced numerous complaints and suits from area ranchers concerning damage to property from tailings deposition and smelter smoke. These suits required the Anaconda Copper Mining Company to expand its facility through the purchase of easements on adjacent lands.

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[134] "Report on Sampling and Metallurgical Investigation of the Lower Old Works Tailings Dump," 1938, Box 65, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, pp. A-B.

[135] "Anaconda Copper Mining Company, Reductions Department Research Department, Old Work Tailings," February 21, 1938, Box 65, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 1.

Flue Dust Operable Unit

Flue dust was one of the more serious problems facing the Anaconda Copper Mining Company at its Anaconda smelter. As discussed in section 3.2 of this report, the company sought various means to control emissions at its facilities. These included the construction of a new flue system and an enormous 585 foot high stack in 1903. Still, complaints and lawsuits stemming from these daily emissions plagued the company.

3.7 Anaconda Ponds System (Warm Springs, Anaconda, Opportunity)

Location

The vast milling operations at Anaconda over the course of nearly a century necessitated construction of an increasingly large complex of ponds to mitigate the loss of metals and industrial waste downstream. Unlike the tailings ponds in the Butte district, which were built either in, or adjacent to, the channel of Silver Bow Creek, the ponds below the Anaconda Reduction Works were mostly constructed on the plain of the Deer Lodge Valley, between Mill Creek and Warm Springs Creek, and controlled to a certain extent with floodgates, dikes and irrigation ditches (see Figure 3).

Ownership

The initial tailings ponds were located on land originally owned by the Anaconda Copper Mining Company. The remaining parcels were purchased between the 1890s and 1920s, mostly from ranchers or the State of Montana.

Duration and Type of Operation/Deposition of Hazardous Substances

As discussed in greater detail in section 3.5 above, the Anaconda Copper Mining Company deposited hazardous substances in waters adjacent to its Anaconda facility. The company constructed six slum ponds near the Anaconda Reduction Works smelter to receive slimes sometime before 1910. The ponds were tiered from south to north between the Butte, Anaconda and Pacific Railroad (BA&P) and the old Montana Union track, just northeast of the Anaconda Reduction Works. The slum ponds could not handle the volume of slimes and the

overflow was "sluiced down the valley."[136] For five or six months each winter, "most all the slums" were allowed to "pass over this spillway [spillway of the tailings dam]" and flow down to the Clark Fork River. During high water, the creek deposited heavy tailings on the bordering ranch lands. Anaconda Copper Mining Company employees proposed that the company pay ranchers to let "these ranch lands become a tailings and slum field whenever the river is high and will not carry the tailings."[137]

The company also built five tailings ponds to catch the overflow in 1910. These were located about eight miles east of the works and one mile west of Silver Bow Creek.[138] Meanwhile, drainage from the tailings pond just east of the plant caused concern. The tailings were sluiced in flumes over the BA&P and deposited in a large field (roughly one square mile) bounded on the north and east by dikes that paralleled the Montana Union track and the highway to Big Hole, respectively. Floodgates in the latter dike allowed the excess tailings water to enter a ditch which meandered easterly to Silver Bow Creek, joining the creek by French Crossing Ranch.[139] Excavation was begun on "Tailings Pond A" in 1914, an even larger pond about three miles east of the smelter, which would intercept the overflow both from the six original slum ponds and the upper tailings area, reducing the load on the five tailings and slime ponds near Silver Bow Creek. Due to the large production of tailings during the 1940s, however, the excavation of Pond A did not keep pace with the tailings disposal.[140]

By 1917, the situation was critical, and plans prepared for new and larger tailings ponds to occupy the area between the Pond A and the five tailing ponds. Two more ponds were to be

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[136] William F. Flynn, "Report on Tailings Disposal at Anaconda Reduction Works" (January 1937), Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[137] F.C. Noble to William Wraith, February 1, 1912, Box 441, Folder 11, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[138] William F. Flynn, "Report on Tailings Disposal at Anaconda Reduction Works," January 1937, Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana. The report calls it Deer Lodge River (the Clark Fork River). Today the Silver Bow does not become the Clark Fork until it meets Warm Springs Creek at Warm Springs, about three miles north (downstream) from these ponds.

[139] Ibid.

[140] Ibid.

located on the Clark Fork River, where Warm Springs Creek flows into Silver Bow Creek, to collect the overflow, as well as settle the tailings that came down the Silver Bow from the Butte district. The ponds above the creek were labelled B1, B2, C1 and C2, (Opportunity Ponds) while those on the Clark Fork River by Warm Springs were WS1 and WS2 (Warm Springs Ponds).[141] Design and construction of the new ponds was assigned to H.W. Aldrich — William Flynn was his engineer in charge of dams. Flynn soon encountered problems. The high water table and soft ground in the area of the B and C ponds caused the dam walls to slough off until they "were nothing more than dykes [sic]."[142]

In the fall of 1918, Ponds B1 and C1 were opened; B2, C2, WS1 and WS2 were completed and in operation by 1920. The tailings entered the system from feed ditches. By opening one ditch and then another, a crossflow over the whole area was achieved, minimizing the water's velocity and thus the force on the dikes. About 75% to 80% of the tailings were settled in the B and C ponds, the remainder discharging into Silver Bow Creek and then into the Warm Springs Ponds, where 6 inches to 24 inches of water covered 40 to 100 acres, and "practically 100%" tailings settlement was achieved.[143]

The original tailings area directly east of the works raised a dust problem in 1926. Six to 12 inches of slimes from the zinc concentrator were deposited over the surface. When this dried up in the summer of 1927, it created a worse problem. The area had become too mounded to wet down with slimes again. A 4-foot retaining wall did not work, and in 1929 and 1930 the area was covered with granulated slag to a depth of 4 inches to 6 inches. Wind erosion gradually removed the layer of slag.[144]

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[141] Ibid. For the location and designation of the ponds see map (Figure 1), "A.C.M. Co. Tailings Fields and Ditches," dated March 23, 1938 in E.P. Dimock, "Report on Tailings Disposal at the Anaconda Reduction Works," February 20, 1947, Box 91, Folder 1, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[142] W.C. Capron, "Report on Tailings Disposal Plant at Opportunity and Clarifying Plant at Warm Springs," September 28, 1922, Box 90, Folder 10, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 3.

[143] Flynn, "Report on Tailings Disposal at Anaconda Reduction Works," January 1937, Box 383, Folder 383-6, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[144] Ibid.

The B and C ponds sufficed through the 1940s. Pond B-1 received water diverted from Silver Bow Creek via the Silver Bow Ditch. Pond B-2 received the bulk of the tailings, plus acid water from the plant, slag water and sewage from Anaconda, the overflow passing into ponds C-1 and C-2.[145]

In 1947, new ponds were begun overlaying the old tailings area east of the plant. These were called Ponds 1 and 2. Dikes about 25 feet high were built around the perimeter, and the tailings were delivered through 28 inch pipes on high wooden trestles.[146] After ten years the dike around Pond 1 had been raised to a height of 100 feet. Each pond covered approximately 240 acres. Pond 1 was filled to within 12 feet of the rim. Raising the dike level any more was too costly and a new system of tailings disposal had to be found.[147]

A long range plan was conceived to raise the dikes up 90 feet around the entire area of the A, B and C ponds. The new pond would span 4,200 acres and have a capacity of 400 million tons. An interim plan called for the deposition of 50% tailings in Ponds 1 and 2, and 50% in the C-2 pond and a borrow pit where sand-fill for mines was drawn from. The borrow pit would receive about 2.5 million tons of tailings.[148] The dikes for the new pond overlaying the old A, B and C ponds were begun in 1956. The area for tailings settlement was surrounded by outer dikes for slimes settlement. The overflow left the pond through concrete decanting towers and passed below ground through drain lines to Silver Bow Creek. This water had a pH of 11.0, which necessitated a clarifying pond downstream to supplement the Warm Springs ponds. The "New River Pond" was completed around 1957.[149]

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[145] Map (Figure 1), "A.C.M. Co. Tailings Fields ..." in Dimock, "Report on Tailings Disposal ...," Box 91, Folder 1, ACM Co. Papers, MHS Collection 169, Helena, Montana.

[146] Ralph Constantini, "Report on Tailings Disposal Operations at the Anaconda Reduction Department," September 19, 1957, Box 90, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 1.

[147] Ibid., pp. 1 and 3.

[148] R. Constantini, "Tailings Disposal Study for Proposed Butte Concentrator," June 24, 1958, Box 87, Folder 13, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 3; R. Constantini, "Report on Tailings Disposal Operations at the Anaconda Reduction Department," September 19, 1957, Box 90, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, pp. 5-6.

[149] R. Constantini, "Report on Tailings Disposal Operations at the Anaconda Reduction Department," September 19, 1957, Box 90, Folder 9, ACM Co. Papers, MHS Collection 169, Helena, Montana, p. 2.

3.8 Rocker Timber Framing and Treating Plant

The Anaconda Copper Mining Company constructed a timber treatment plant at Rocker, a small community west of Butte, during the early 1900s. The plant was located adjacent to Silver Bow Creek and the tracks of the Northern Pacific Railroad (Figure 4).

Prior to construction of the plant, mine owners and operators in the Butte area cut mine timbers (stulls) and constructed mine support frames according to their own specific needs. The Anaconda Copper Mining Company recognized the economic benefits of introducing a uniform system of framing and treating when it acquired mining properties in Butte during the period of consolidation.[150] Construction of the Rocker Timber Framing and Treating facility was viewed as a way to obviate the problem of varying sizes of mine timbers, facilitate an interchangeable system of mine and rail timbering, and increase the life of mine timbers through treatment.

Initially the Rocker plant included a rectangular building that had a treatment tank that was 45 feet long and 5 feet wide. The mine timbers were fed into the tank and "charged." The "charge" consisted of treating the timbers with:

> three hours under steam, one hour under vacuum, 9 hours of creosote, 1 hour draining, then heated with steam and drawn off and added hot creosote 240°F, and at 100 lbs. pressure, 9 to 10 hours, one quarter to one half hour after cooling continues to penetrate the timber.[151]

After treatment the mine timbers were delivered to the company mines on Butte Hill.

Fire destroyed the Rocker Timber Framing and Treating Plant in 1925.[152] Although the plant was rebuilt, the practice of treating the mine timbers with creosote was terminated because

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[150] B.H. Dunshee, "Timbering in the Butte Mines", in *Transaction Of The American Institute Of Mining Engineers*, vol. XLVI, (New York: Institute of the Office of the Secretary, 1914), p. 148.

[151] William Walsh, *Biennial Report Of The Inspector Of Mines Of The State Of Montana*, (Helena: Independent Publishing Company, 1910), p. 117.

[152] Robert E. Duyser to R.D. Cole, February 4 and February 6, 1926, Box 125, File 125-5, ACM Co. Papers, MHS Collection 169, Helena, Montana.

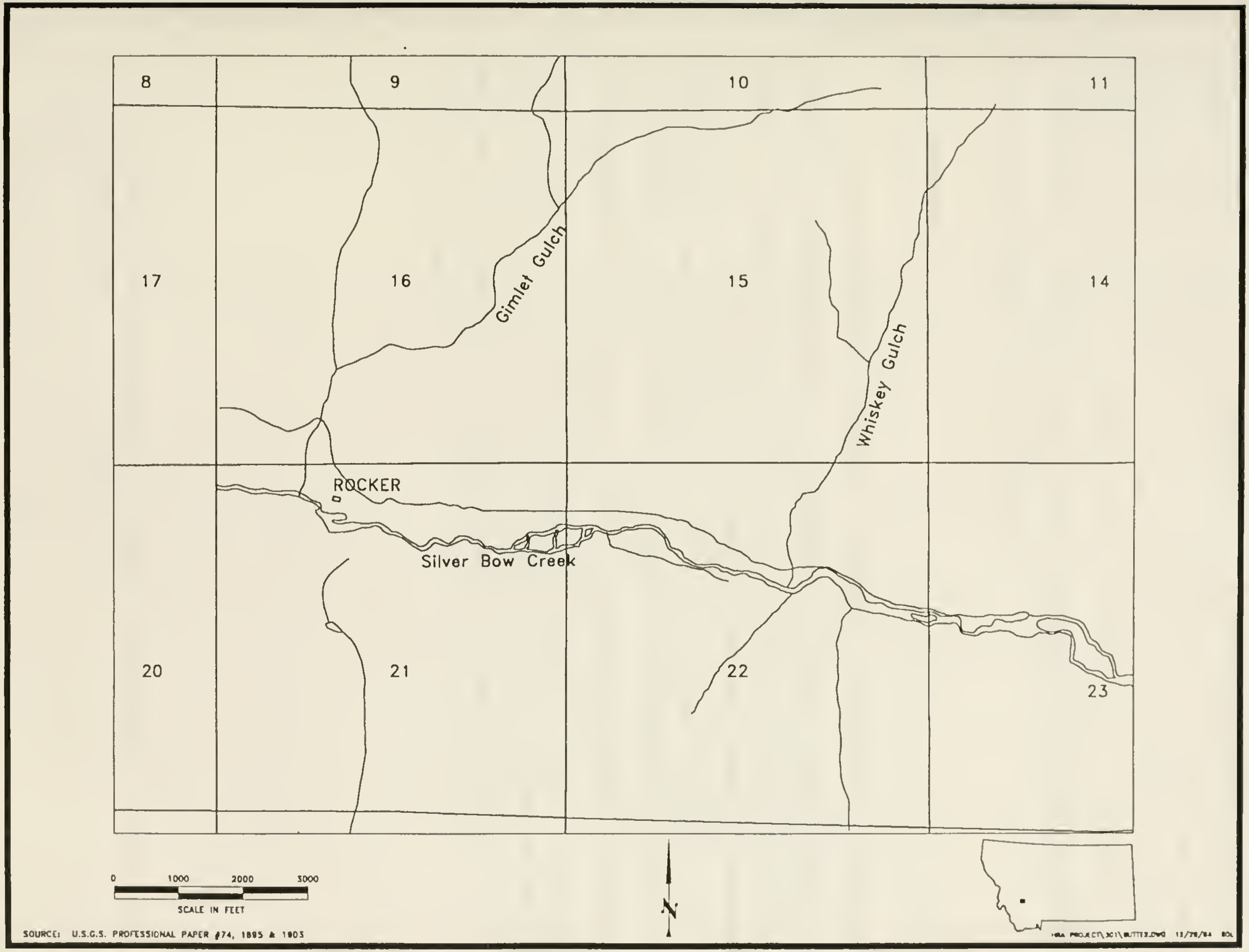

Figure 4. Location of Rocker Timber Framing and Treating Plant.

of the flammable nature of the treatment material. The company replaced the creosote treatment with an arsenic based compound obtained from the arsenic plant at the Anaconda Reduction Works in Anaconda. Thereafter, process used at the Rocker plant involved subjecting pre-cut mine timbers to a "pickler" where they were submerged in a hot arsenic compound for 24 hours. The treated timbers were then delivered, as necessary, to the individual mines.[153] The treatment plant at Rocker operated until 1957, when the buildings on the site were destroyed and the site was abandoned.[154]

4.0 Conclusion

The late 19th and early 20th century mining history of Silver Bow and Deer Lodge Counties can largely be understood by chronicling the rise of the Anaconda Copper Mining Company. Through acquisition of its predecessors in interest, the Anaconda Copper Mining Company was able to consolidate mining and smelting operations in Butte and Anaconda by 1906 and thereby control copper production in the area. The company's operations, and those of its predecessors in interest, resulted in the deposition of large quantities of waste in Silver Bow and Warm Springs Creeks and, eventually, into the Clark Fork River. The Anaconda Copper Mining Company acknowledged the problems caused by these wastes in the late 1890s and early 1900s. Construction of ponds and the acquisition of lands and easements during this period were direct responses to the recognized deposition of hazardous substances into these south central Montana waters.

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[153] United States Environmental Protection Agency, "Remedial Activities Uncontrolled Hazardous Waste Sites in the Zone of Regions VI, VII, VIII", June 1992, p. 2-3.

[154] Ibid.

Glossary of Mining Terms[155]

Alkaline	Applied to minerals having the taste of soda.
Argentiferous	Containing silver.
Barren	Not containing mineral of value.
Bessemer process	The process of decarburizing a bath of molten cast iron by blowing air through it in a vessel called a converter. Other impurities, in small amounts, are also eliminated. Also, by analogy, the enrichment of copper matte by blowing air though it when molten, thus oxidizing the sulphur which escapes as SO_2. The iron combines with silica, forming a slag.
Blake crusher	The original crusher of jaw type. A crusher with one fixed jaw plate and one pivoted at the top so as to give the greatest movement on the smallest lump. Motion is imparted to the lower end of the crushing jaw by toggle joint operated by eccentric.
Blast furnace	A furnace in which combustion is forced by a current of air under pressure, especially for smelting ores. A blast furnace is designated as hot-blast or cold-blast according to the temperature of the air used for the blast. The furnace is usually vertical, but varies greatly in size and shape.
Bruckner cylinder	A form of revolving roasting furnace.
Bruckner furnace	A horizontal revolving, cylindrical furnace for roasting pulverized sulphide ores.
Calcining furnace	A furnace used for roasting ore in order to drive off certain impurities.
Catchment basin	The entire area from which drainage is received by a reservoir, river, or the like.
Classifier	A machine for grading the feed to concentrators so that each individual concentrator will receive its proper feed. Classifiers may be hydraulic or surface-current box classifiers (spitzkasten). Classifiers are also used to separate sand from slime, water from sand, and water from slime.
Concentration	The removal by mechanical means of the lighter and less valuable portions of ore.
Concentrator	An apparatus in which, by the aid of water or air and specific gravity, mechanical concentration of ores is performed. Also applied to the entire plant containing the various concentrating devices, or machinery. A concentration plant.
Copper	A common metal of reddish color, ductile, malleable, and very tenacious. One of the best conductors of heat and electricity.

[155] Albert H. Fay, *A Glossary of the Mining and Mineral Industry*, U.S. Department of the Interior, Bureau of Mines, (Washington: Government Printing Office, 1920).

Cornish pump — A pump operated by rods attached to the beam of a single-acting, condensing beam-engine. The steam, pressing down the piston in the vertical steam cylinder, lifts the pump rods, and these subsequently descend by their own weight.

Crushers — A machine for crushing rock or other materials.

Dike — A long and relatively thin body of igneous rock, which, while in a state of fusion, has entered a fissure in older rocks and has there chilled and solidified. Not to be confounded with vein. Also spelled Dyke.

Flue — A passage for air, gas, or smoke.

Fluedust — Dust composed of particles of unchanged or oxidized ore, volatized lead that has been converted into oxide, carbonate and sulphate, and of fuel. It may also include other volatilized products, as of arsenic, zinc, etc.

Flume — An inclined channel usually of wood and often supported on a trestle, for conveying water from a distance to be utilized for power, transportation, etc.; A mill tail.

Frue vanners — An ore-dressing apparatus consisting essentially of a rubber belt traveling up a slight inclination. The material to be treated is washed by a constant flow of water while the entire belt is meanwhile shaken from side to side. Other vanners of the side-shake type are the Tulloch, Johnston, and Norbom.

Fume — Consists of metals or metallic compounds that have been volatilized at the high temperatures of the furnaces, condensed at lower temperatures, and carried by furnace gases into the flues. Sulphur trioxide and elemental sulphur, driven off from furnaces and condensed, are also classed as fume.

In general, all the volatile constituents of the ore charge are represented. The fume frequently contains appreciable amounts of silver, which is decidedly volatile under certain conditions. The particles of fume are very fine and are under the stress of certain physical forces, so they do not settle easily, as most of the flue dust does, but in large proportion pass through the stack with the gases and spread over the surrounding country, unless special preventive methods are used.

Furnace — A structure in which, with the aid of heat so produced, the operation of roasting, reduction, fusion, steam-generation, desiccation, etc. are carried on, or, as in some mines, the upcast air current is heated, to facilitate its ascent and thus aid ventilation.

Groundwater — The water which permeates, in an unbroken sheet, the rock masses of the earth, filling their pores and fissures.

Harz jigs — A jig in which pulsion is given intermittently with suction. The periods devoted to them are about equal.

Heap roasting — Burning the sulphur out of ores piled in heaps, with a small amount of wood or other fuel.

Jig	A machine or apparatus in which ore is concentrated, or coal is separated from slate, on a screen or sieve in water by a reciprocating motion of the screen, or by the pulsion of water through the screen.
Keller-furnace	A multiple-deck roasting furnace for sulphide ore. It is a modification of the Spence furnace.
Launder	A trough, channel, or gutter, by which water is conveyed; specifically in mining, a chute or trough for conveying powdered ore, or for carrying water to or from the crushing apparatus.
Leach	To wash or drain by percolation. To dissolve minerals or metals out of the ore, as by the use of cyanide or chlorine solutions, acids, or water.
Lode	Strictly a fissure in the country-rock filled with mineral; usually applied to metalliferous lodes. In general miners' usage, a lode, vein, or ledge is a tabular deposit of valuable mineral between definite boundaries. Whether it be a fissure formation or not is not always known, and does not affect the legal title under the United States Federal and local statutes and customs relative to lodes. But it must not be a placer, i.e., it must consist of quartz or other rock in place, and bearing valuable mineral.
Manganese	A hard, brittle metallic element having a grayish-white color tinged with red and rusting like iron. Not magnetic.
Manhes converter	A purifying and oxidizing process for removing sulphur from copper matte, by subjecting the molten matte to a blast of air; named from the inventor.
Matte	A product obtained in smelting sulphide ores of certain metals, as copper, lead, or nickel. It is crude metal combined with more or less sulphur, and requires to be further purified. Matte is brittle and the fracture ranges from coarse grained through fine grained to conchoidal; its color is bronze-like, often bluish, again dark to a light gray; the luster is bright. Copper matte usually contains 30 to 40 per cent sulphur.
Nodulize	To convert into nodules, as finely divided ores.
O'Hara furnace	A horizontal, double-hearth furnace for calcining sulphide ores.
Oxidize	To unite with oxygen. Many minerals and most metals oxidize with greater or less rapidity when exposed to air or water.
Percolate	To pass through fine interstices; to filter; as water percolates through porous stones.
Pickle	In metal working, a bath of dilute sulfuric or nitric acid, etc. to remove burnt sand, scale, rust, etc., from the surface of castings, or other metallic articles. To treat with, or steep in, pickle.
Placer	A place where gold is obtained by washing; an alluvial or glacial deposit, as of sand or gravel, containing particles of gold or other valuable mineral.
Portal	The surface entrance to a drift, tunnel, adit or entry.

Precipitation process	The treatment of lead ores by direct fusion with metallic iron or slag or ore rich in iron; performed generally in a shaft-furnace, rarely in a reverberatory. Often combined with the roasting and reduction process.
Pulp	Pulverized ore mixed with water; also applied to dry-crushed ore.
Pyrites (copper)	A mineral that strikes fire. The term is applied to any number of metallic-looking sulphides.
Quartz mine	A mine in which the deposits of ore are found in veins or fissures in the rocks forming the earth's crust. Usually applied to lode gold mines, but not to placers.
Reduction	The act of removing oxygen. The process of separating metals from their ores.
Reverberate	To deflect flame or heat, as in a reverberatory furnace.
Reverberatory furnace	A furnace in which ore is submitted to the action of flame without contact with the fuel. The flame enters from the side or end, passes upward over a low wall or bridge, strikes the roof (arch) of the furnace, and is reverberated downward upon the charge.
Rittinger table	A side-bump table with plane surface, actuated by a cam, spring, and bumping post.
Roasting	Calcination, usually with oxidation. Good, dead, or sweet roasting is complete roasting, i.e., carried on until sulphurous and arsenious fumes cease to be given off. Kernel-roasting is a process of treating poor sulphide copper ores, by roasting in lumps, whereby copper (and nickel) are concentrated in the interior of the lumps.
Rolls	Cast-iron cylinders, either plain or fitted with steel teeth, used to break coal and other materials into various sizes. Applied to the type of crushing machinery in which the ore is broken between cylindrical rolls which rotate in a vertical plane.
Shaft	An excavation of limited area compared with its depth, made for finding or mining ore or coal, raising water, ore, rock, or coal, hoisting and lowering men and material or ventilating underground workings. The term is often specifically applied to approximately vertical shafts, as distinguished from an incline or inclined shaft.
Sieve	The screen or grating fixed in a stamp-box.
Siliceous	Of or pertaining to silica; containing silica or partaking of its nature.
Slag	The vitreous mass separated from the fused metals in smelting ores.
Slime	A product of wet crushing containing valuable ore in particles so fine as to be carried in suspension by water.
Slime-pit (pond)	A tank or large reservoir of any kind into which the slimes are conducted in order that they may have time to settle, or in which they may be reserved for subsequent treatment.

Sluice	A long, inclined trough, launder, or flume, usually on the ground, for washing auriferous earth, floating down logs, etc. In gold mining such a contrivance is paved with riffles, etc. to hold the quicksilver for catching the gold.
Slums	The discharge or waste from hydraulic mines. See *Tailings* and *Slime*.
Smelt	To reduce metals from their ores by a process that includes fusion. In its restricted sense *smelting* is confined to a single operation, as the fusion of an iron ore in a shaft furnace, the reduction of a copper matte in a reverberatory furnace, and the extraction of a metal from sweepings in a crucible; but in its general sense it includes the entire treatment of the material from the crude ore to the finished metal, and embraces: (a) the calcination or roasting, by means of which the sulphur and other volatile constituents are expelled; (b) The reduction of the resulting furnace products, or the smelting proper, and (c) the refining of the product from the second operation.
Smelter	An establishment where ores are smeltered.
Spillway	A passage for superfluous water in a reservoir, to prevent too great pressure on the dam.
Stack	A chimney. A shaft furnace.
Stall roasting	The roasting of ore in small enclosures of earth or masonry walls. The enclosures are called stalls and may be open or closed.
Steam-stamps	A crushing machine consisting of a vertical stamp-shaft which is forced down to strike its blow, and lifted up preparatory to striking the next, by a steam piston.
Surface mining	Mining at or near the surface; placer mining; open-pit mining.
Surface working	Same as Surface mining.
Tail water	Water in a tail race.
Tailings	The parts, or a part, of any incoherent or fluid material separated as refuse, or separately treated as inferior in quality or value; leavings; remainders; dregs.
Vanner	A machine for dressing ore; an ore-separator; a vanning machine. The name is given to various patented devices in which the peculiar motions of the shovel in the miner's hands in the operation of making a van are, or are supposed to be, more or less successfully imitated.
Veins	An occurrence of ore, usually disseminated through a gangue, or veinstone, and having a more or less regular development in length, width, and depth. A vein and a lode are, in common usage, essentially the same thing, the former being rather the scientific, the latter the miners' name for it. A *vein* or *lode* as used in the law applies to any zone or belt of mineralized rock lying within boundaries clearly separating it from the neighboring rock. A comparatively thin sheet of igneous rock injected into a crevice in rock. When this intrusion is large it is called a dike.

Watercourse A natural or artificial channel for passage of water as a river, canal, flume, or drainage tunnel.

Water jackets Cast- or wrought-iron sections of a furnace so constructed as to allow free circulation of water for keeping the furnace cool.

Wethey furnace A multiple-deck, horizontal furnace for calcining sulphide ores. Resembles the Keller furnace.

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